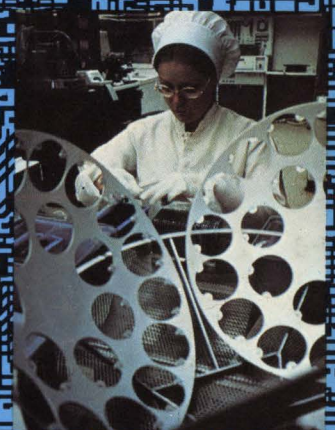
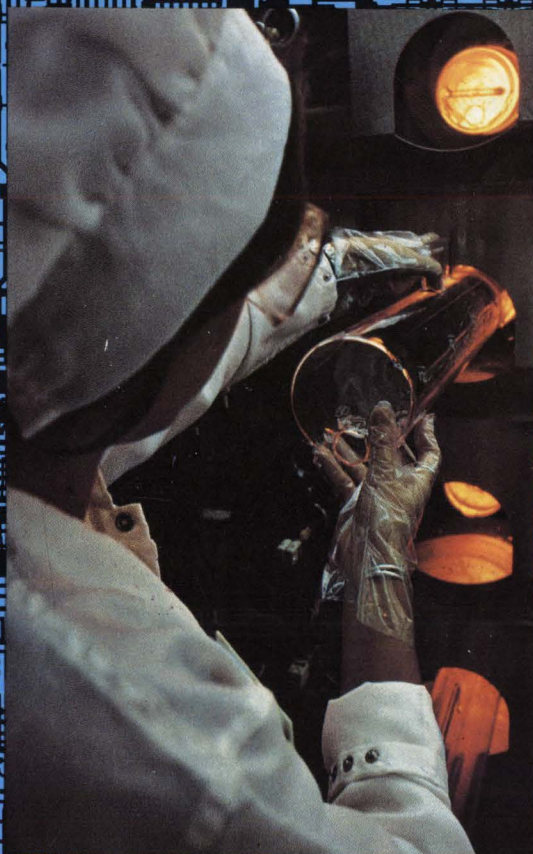


mini-micro systems

AUGUST 1976

formerly MODERN DATA



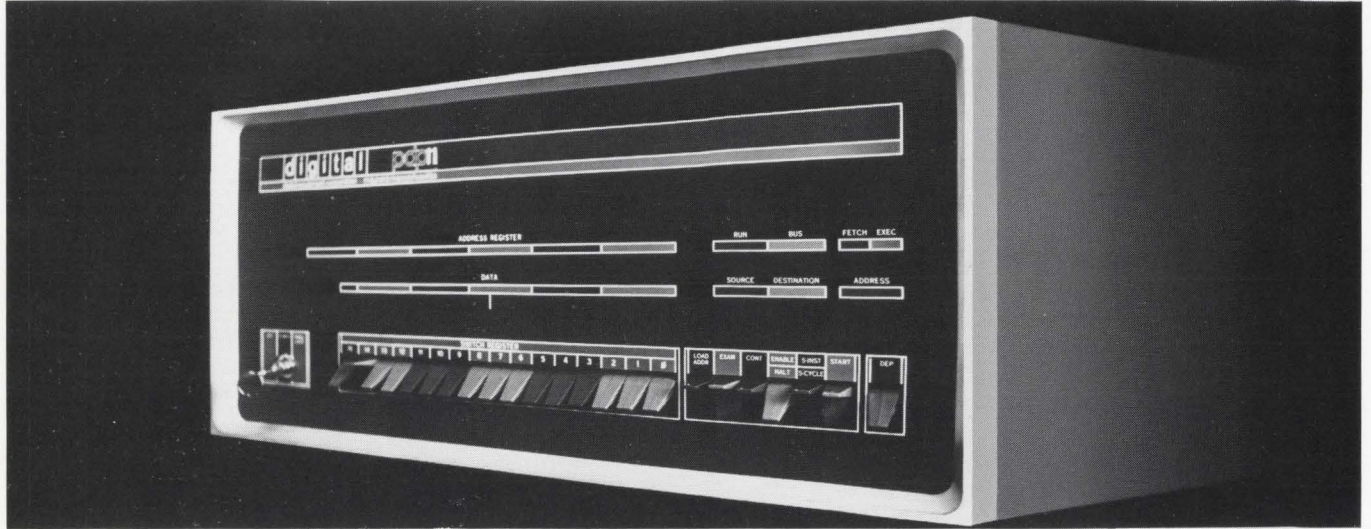
PRODUCT PROFILE: Minicomputers

WESCON/76 Preview

Boosting Network Response Time

FORTH - New approach to mini-micro software

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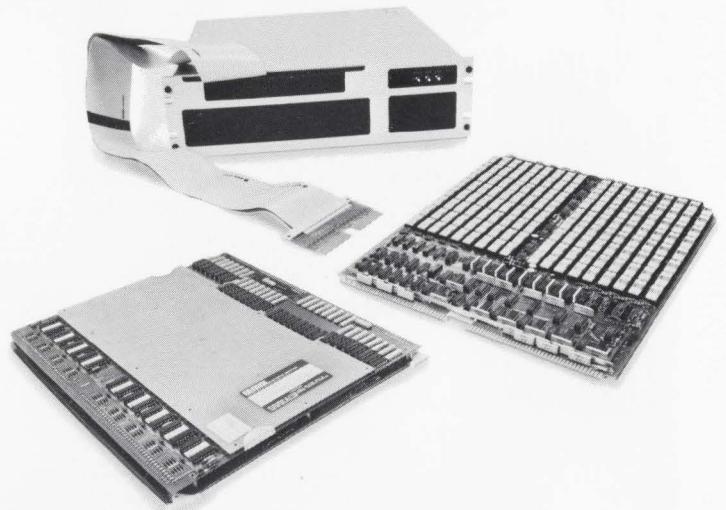
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CIRCLE NO. 5 ON INQUIRY CARD

MINI-MICRO SYSTEMS / August 1976

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formerly Modern Data

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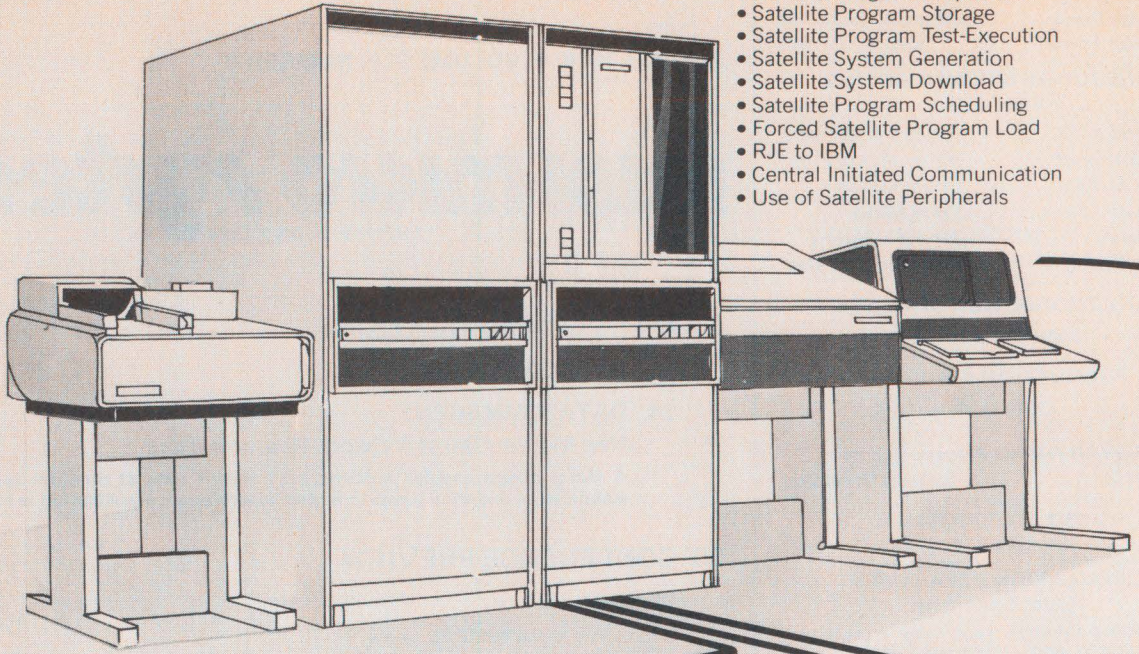
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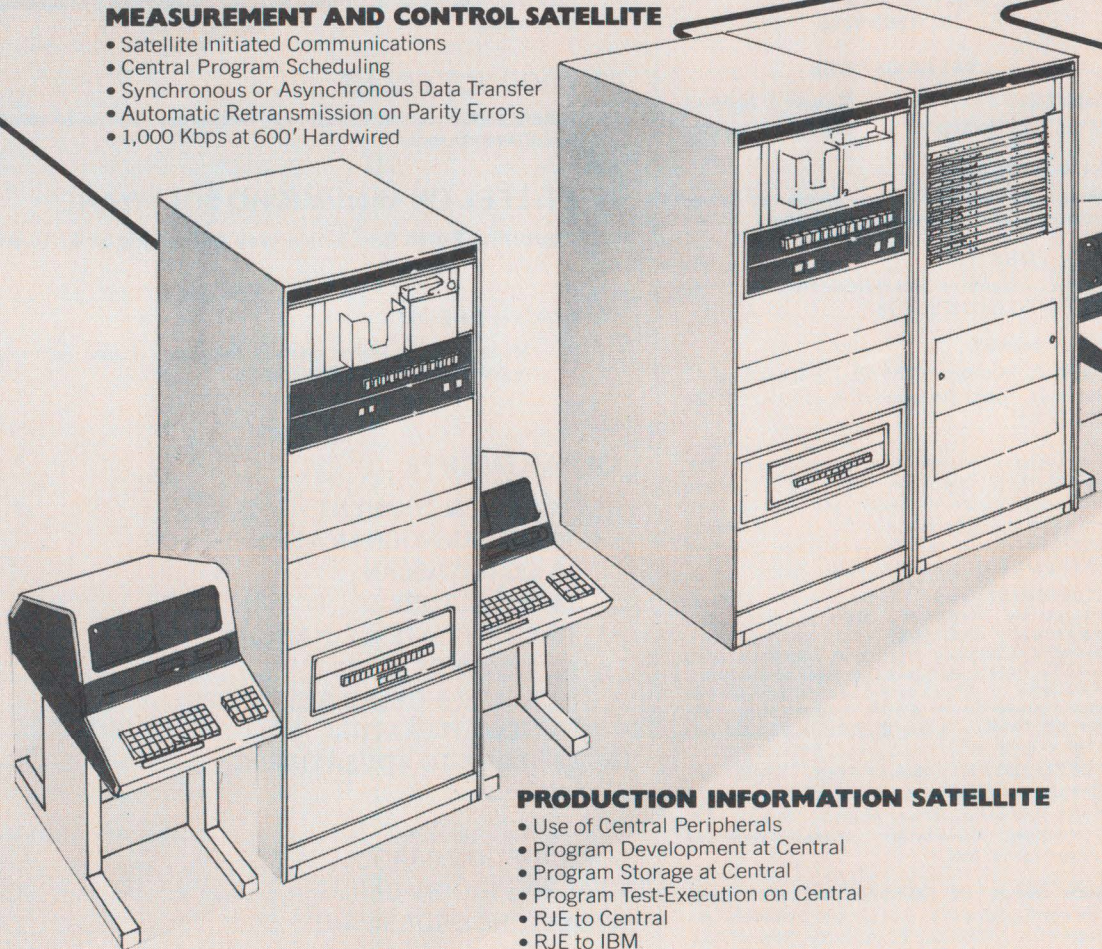
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- Satellite Program Preparation
- Satellite Program Storage
- Satellite Program Test-Execution
- Satellite System Generation
- Satellite System Download
- Satellite Program Scheduling
- Forced Satellite Program Load
- RJE to IBM
- Central Initiated Communication
- Use of Satellite Peripherals



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22617

INTERSIL AND AMS MERGE

Semiconductor manufacturer *Intersil, Inc.*, and add-on memory maker *Advanced Memory Systems, Inc.*, have decided to merge. Intersil, developer of the 12-bit processor chip that uses the PDP-8 software, had been looking for a partner with a good cash position. Last year, it had a net loss of \$2.9 million, compared to a 1974 profit of \$145,000. AMS has the needed funds for Intersil to market its new products: its most recent quarterly profit was \$1.4 million compared to \$439,000 in the same quarter of last year. AMS President Orion Hoch will be president and chief executive officer of the combined venture. Under the terms of the agreement, .95 shares of AMS stock will be exchanged for each outstanding share of Intersil common stock.

WHEN IN DOUBT — SPECIALIZE

Specialized application terminals — POS, commercial teller, credit card authorization, EFTS, stock quotation and portable data collection — numbered 437,000 in 1975 according to an *International Data Corp.* (Waltham, MA) study. By 1980, IDC predicts there will be 2.3 billion. This amounts to a compounded 40 percent annual growth rate, compared to IDC's estimate of a 15 percent growth rate for the general purpose terminal market. Supermarket and merchandise POS systems will be one of the main beneficiaries, but other growing markets will include reservation systems, crime information systems, stock transaction terminals and voting terminals.

FOR SALE: AT&T COMPETITOR

Competing with a monopoly can be expensive. And Wyly Corp., the financial backer of Data Transmission Co. (Datran), is finding competing with AT&T long lines prohibitively expensive — so much so that it wants to sell or merge Datran. Unlike AT&T's long lines, Datran's Datadial service, which has been operating since January, 1975, charges only for transmission facilities actually used, instead of dedicated line service. Wyly has already provided \$43 million to Datran, giving it a present consolidated debt of \$112 million. It owes about half of this to Datran's other financial backer, Haefner Holding AG of Zurich.

DEC'S PDP-8 PUSH

There's still nothing like a tried and proven "8" is the attitude of many PDP-8 users. Rather than fight it, DEC is joining it and has therefore split the PDP-11 and PDP-8 OEM marketing groups and consolidated all the PDP-8 marketing groups under one banner. The new group will be responsible for industrial, laboratory, educational, engineering, computation, communications and OEM sales. There are over 30,000 PDP-8s installed, which means there are a lot of users dependent on the software developed for the 12-bit machine. And even with the price breakthroughs of the 11/03 (LSI-11 boxed version), the PDP-8 is faster, has proven reliability and more expansion capability, and it's easy to program. The newest 8, the 8/A, was introduced in 1974. With a 4K RAM, it sells for \$2495. The other 8s being marketed, the 8/E, 8/F and 8/M, have a different processor and are in the \$5000 range.

WITHOUT FS, WHAT NEXT?

IBM's Future Systems, initially scheduled for introduction between 1976 and 1978, has been put off indefinitely if not forever. IBM's next course of action to prevent independents such as Amdahl from eroding its 360/370 customer base until a future-type system is introduced can only be projected. Industry observers expect it will be an advanced function, data base/data communications system. Two observers, namely International Data Corp. and the Computer Industry Association, have gone further than generalities in a four-part joint study that explores past and future IBM strategies.

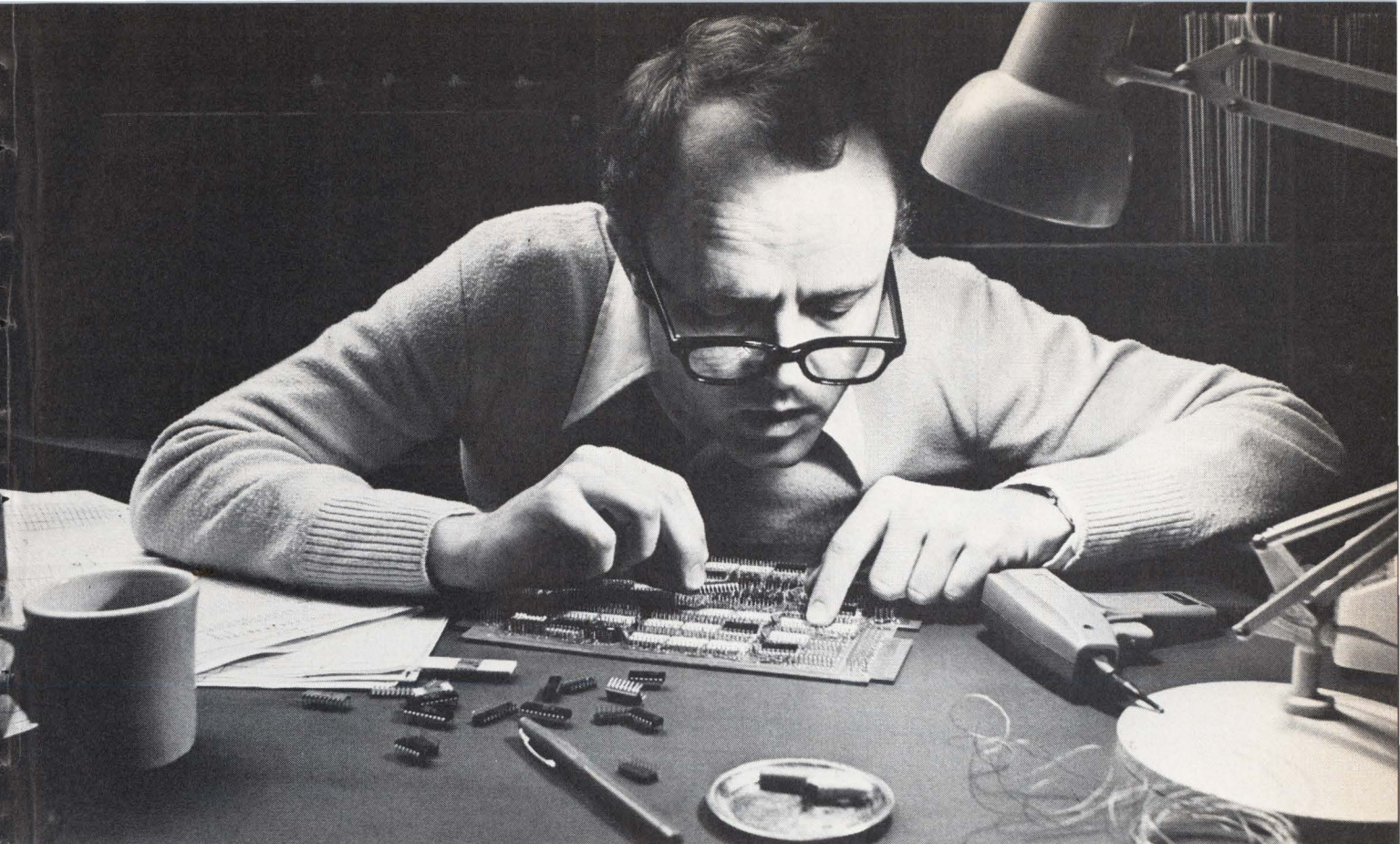
Details of IBM's planned, but never introduced, Hierarchical Memory System are included in the *Advanced Function Package*. Also included in the 200-page package is IBM's ratings of its advanced function products (virtual memory, multiprocessing and sensor-based systems). The *System Q Package* explains the often misinterpreted System Q. Sometimes thought to be the operating system for FS, it was actually planned FS hardware/software emulation for the 360/370 user until they could convert. This 240-page report also gives a schedule of product introductions from the first 370 to FS. Other packages are the *Satellite Communication Package* and the *Memory Package*. Each report contains inhouse IBM reports and competitive information. Price of each is \$99. Write *International Data Corp., P.O. Box 915, Waltham, MA 02154*.

WESTERN DIGITAL HANGS ON

Western Digital recently got a month's reprieve from impending bankruptcy so it can continue its search for a partner with \$2 million to \$4 million in cash. Western Digital is DEC's primary source for the LSI-11 chip sets, although the company also manufactures other chips. When Western Digital's financial position began to weaken, DEC agreed to build up its inventory of LSI-11 chip sets. But inventories became too large and it had to cut its monthly order to one-quarter of its previous size. Meanwhile, DEC also started its own LSI-11 manufacturing facilities in Worcester, MA — not so much as a second source, but as a learning experiment on what goes into chip design and manufacture. This way DEC feels it will know what to demand in chip design for its own applications.

WHAT'S COMING

- Sept. Compton 76.** (Thirteenth IEEE Computer Society 7-10 International Conference). Mayflower Hotel, Washington, DC 90036. Contact Compton 76 Fall, PO Box 639, Silver Spring, MD 20901.
- 14-17 Wescon/76.** Los Angeles Convention Center, Los Angeles, CA. Contact Wescon, 999 North Sepulveda Blvd., Suite 410, El Segundo, CA 90245.
- 28-30 1976 Canadian Computer Show and Conference.** Place Bonaventure, Montreal. Contact Canadian Computer Show, 481 University Ave., Toronto, Canada M5W 1A7.
- Oct. New England Computer Show.** Chateau de Ville, Framingham, MA. Contact Norm De Nardi Enterprises, 95 Main St., Los Altos, CA 94022.
- 18-20 Microprocessors and Microcomputers Course.** Fairmont Hotel, San Francisco, CA 94106. Contact Institute for Advanced Technology, 6003 Executive Blvd., Rockville, MD 20852.



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If you're thinking of making your own micro-computer boards sometime in the future, ours are the only boards to buy right now.

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Which means you can switch from microNOVA boards to our microNOVA chips anytime you want.

The microNOVA board is a full 4K micro-computer. With a number of standard features. Like power-fail/auto-restart. Real-time clock. NOVA instruction set with hardware stack. Hardware multiply/divide. Data channel logic.

Yet all the above computer costs only \$589, in OEM quantities of 100*.

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RTOS, our NOVA-compatible, field proven realtime executive. And it runs both Assembler and FORTRAN.

And because the microNOVA board comes from Data General, it comes with the manuals, technical publications, services, training courses and seminars you'd expect from a large minicomputer company.

Yet the microNOVA 4K board is only one member of an entire family. Besides the board (and all the supporting boards), you can get complete development systems. Or you can get completely packaged MOS minicomputers. Or chip sets that include the mN601 CPU, plus all the supporting chips.

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A company actively engaged in manufacturing fixed-head discs and tape drives, video recording and display equipment, and clustered terminal systems — an industry leader in future development within these product areas.

We are headquartered in Sunnyvale, California in a ninety-three thousand square foot complex; with additional manufacturing in Singapore, and sales and service centers in major U.S. and European markets.

In our thirteen years to date (under the banners of Data Disc and Bright), we have served an ever-widening spectrum of clientele, both large and small — computer systems manufacturers, prime users, and military and governmental organizations.

We would sincerely welcome the opportunity to be of service to you, too.

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Sunnyvale, CA 94086
(408) 732-7330.

AMCOMP

ADAPSO ON INTERNATIONAL MARKETING

As distributed processing disperses itself across national boundaries, cooperation among data processing organizations becomes mandatory. Jerome Dreyer, vice president of Adapso, recently stressed that point for the European Computing Services Association Conference on Small Business Computers and Telecommunications. He called for an international counterpart to Adapso — a centrally located International Secretariat and Clearing House to serve the worldwide data processing industry. That would include an online data bank, containing information such as national laws, trade union regulations, banking laws, currency and customs of the people for specific countries. Although the Secretariat would be funded originally by the data processing service organizations, it would eventually be open to others.

FAIRCHILD HELPS EAST WITH SEMICONDUCTORS

The U.S. Dept. of Commerce has given Fairchild the go-ahead to supply the Hungarians with "technological expertise" to assemble semiconductor circuits. Packaged circuits will be assembled in the Tungstam United Lamp Works in Budapest with bipolar chips supplied by Fairchild. Final approval by the Hungarian government is needed.

THE MICROFILM EQUIPMENT SUPPLIES & SERVICES MARKET

Sales of microfilm equipment in 1975 will total \$260 million, with readers as the leading product category. By 1976, sales of COM will dislodge readers for first place. By 1977, COM and automatic storage and retrieval will hold the leading two positions. Sales of film, paper and other supplies will add another \$325 million to the 1975 market, and in the services segment sales of micropublishing services will total over \$100 million in 1975.

Frost & Sullivan has completed a 165-page report surveying the major user and applications areas, indicating trends in their present and future usage of microfilm equipment and services and technological developments. Anticipated changes in budgets for microfilm operations are presented in detail. Sales forecasts are given to 1985 for products, supplies and services in these categories: cameras (3 types), processors; readers (2 types), reader/printers (2 types), AS&R; supplies (6 types); services (4 types); and by application/function (4 types) and end user industry (6 types). Characteristics and the state of the art are described for various products; the industry structure is considered; leading suppliers are identified; and long-range application trends are evaluated.

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TYMSHARE'S FRENCH CONNECTIONS

Tymshare is acquiring a 20 percent interest in Sligos, SA, a French computer services company, for payment of \$3 million. The company is also going to increase its ownership in Cegos-Tymshare, its present French affiliate, from 20 to 45 percent for payment of \$1.1 million to Idet-Cegos. Sligos annual revenues were \$32 million last year and it has just become profitable. Cegos-Tymshare has revenues of \$5 million. Both agreements are subject to the approval of the respective Board of Directors and the French Government.

NORTH VIETNAM TURNS FROM WAR TO COMPUTERS

Shortly after the conclusion of the Vietnam War, the North Vietnamese began a joint research project on computer technology with the Soviet Union. Presently, North Vietnam has only a few RYADs, but there is speculation that it will be an assembly plant location for Eastern Bloc computers.

GERMANY'S SMALL BUSINESS MARKET TO DOUBLE BY 1980

Installations of small business computers in Germany, now about 80,000, will double by 1980, according to Dr. Hans-Joachim Grobe of Diebold Deutschland GmbH. The Europeans have had the small business market to themselves with Nixdorf the leader followed by Kienzle, Olivetti and Philips. Nixdorf originally started that market in Germany in the early 60s as an alternative to IBM's large centralized approach. By offering the same hand holding as IBM, it became very successful. So successful that the distributed approach caught on in the U.S. and that IBM entered the market with the System/32. Now Europeans fear IBM will take over this market, too.

SIEMENS GETS PARTNER FOR U.S. MARKETING

Siemens (West Germany) is getting help marketing its OEM peripheral products in the U.S. from General Systems International of Anaheim, CA. Products included in the agreement are disk drives, tape drives, add-on memories and printers. Siemens, the fifth largest electrical and electronic manufacturer in the world, which tried unsuccessfully to "de-Americanize" the data processing industry in Europe through ventures such as Unidata is now trying the alternative — "Europeanize the Americans."

FOOTHOLDS ABROAD

Sankyo International Corp., a Tokyo-based trading company, will market and distribute Lear Siegler's series of CRTs in Japan.

The results of the fifth annual market survey among buyers of minicomputers, microprocessors and miniperipherals are now available in a special 80-page report.

See ad on page 48.



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Our LSI-11, the machine on the left, makes getting into micro-computers easy.

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take either.

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*Prices apply to USA only.

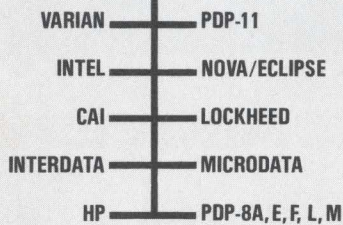
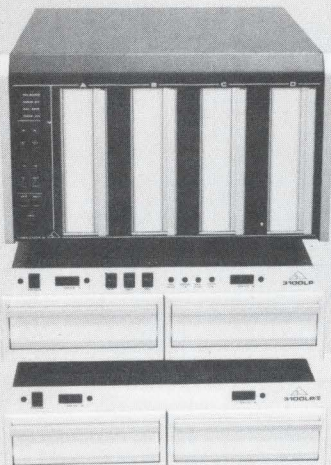
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CIRCLE NO. 8 ON INQUIRY CARD

dc datascan

MORE ON WHAT MAKES A LETTER

Data processing materials are not letters. We've heard that before, but now Adapso (Association of Data Processing Service Organizations) has joined with the National Association of Manufacturers in asking Congress to exclude data processing materials from letter classification. Although data materials have been considered letters under the Private Express Statutes since 1974, they are not subject to postal rates if the transmission is completed within 12 hours or if data processing begins within 36 hours after delivery. However, these conditions impose a hidden tax on data centers, according to Adapso, and also require large expenditures by the Postal Service for inspection of carriers and data processing firms.

PRIVACY BILLS ARE "IN"

Two more states have come up with their own privacy bills governing every automated or manual data system maintained by any man, woman, child, group or corporation. The New Jersey and Wisconsin bills require public notice of the automated system, either in a state newspaper or in some cases, a public hearing. Subjects in the data base must have access to it and the data base organizer has to have written permission before he can release anything from the data base. By trying to correct the privacy abuses by large corporations on the credit card industry, individual states have included anyone and everything in the bills. In the end, the bills will be impossible to enforce and we'll still be without privacy.

IEEE METRIC STANDARD

A source book on metrication recently published by the Institute of Electrical and Electronics Engineers (IEEE) is expected to receive approval as an American National Standard. Developed at the request of the American National Standards Institute, the book includes listing of basic units, supplementary units, and units derived therefrom. Guidance is provided on application of prefixes, other units in use with metric units (including units accepted for limited use and units to be abandoned) and unit selection. A section on style and usage covers the writing of unit symbols and names, pronunciation and recommendations for numbers. Extensive guidance is provided on conversion of linear dimensions, also pressure and stress, along with an extensive

table of conversion factors. The standard reflects the latest actions taken within the CGPM (General Conference on Weights and Measures) and the ISO (International Organization for Standardization) and is a joint effort of the ASTM Special Committee on Metric Practice and the IEEE Standards Coordinating Committee on Quantities and Units. Copies of IEEE Std 268-1976 are obtainable for \$4 from IEEE, 345 E. 47th St., New York, NY 10017.

BENCHMARK GUIDELINES

As summaries of its vast experience with benchmarking, the Federal Government has produced a series of National Bureau of Standards booklets. First came *Benchmarking and Workload Definition* (No. 405). The latest is *Guidelines for Benchmarking the ADP Systems in Competitive Procurement Environment* (FIPS Pub 42). Both are available from the Superintendent of Documents, U.S. Govt. Printing Office, Washington, DC 20402. Cost of the first is \$1.05; guidelines are \$.45.

NEW PUBLICATIONS

Interface Message Processors for the ARPA Computer Network by Frank Heart describes various aspects of the packet switching network's operation and maintenance, including IMP software modifications to permit more than 63 IMPs on the net and more than four host computers on an IMP. Price is \$4.

Computer Network Research by Leonard Kleinrock is a semiannual technical report covering three research fields: communications, security and protection, and algorithmic methods in combinatorially complex problems. Price is \$4.50.

Progress Toward The Crosstie Memory III describes the work done during the last year in this field. In the crosstie memory, information is stored in magnetic domain walls rather than domains and domain wall motion is not used in its operation. Advantages of crosstie are speed, low power, high bit density, nonvolatility and low cost. Price is \$4.

Dynamic Model for Distributed Data Bases by Katriel Dan Levin and Howard Lee Morgan takes into account both the dependencies between programs and data files and the transition costs incurred by file movements from one assignment at a given period to another assignment at the next period. Price is \$4.

To obtain copies, write *National Technical Information Service, U.S. Dept. of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.*

METRIC CONVERSION

The Compass conversion guide contains 40 pages of metric and U.S. equivalents for \$2.95. *Compass Publishing, 701 Investment Bldg., Pittsburgh, PA 15222.*

The *Hero-11 Metric Converter* contains 11 pages of metric equivalents for \$2.50. *Marod's M.S., 178-15, 145 Road Springfield Gardens, NY 11434.*

The *Metric Bulletin* is a monthly newsletter dealing with industrial conversion, legislation and metric product availability. One year subscription is \$60. *J.J. Keller & Associates, 145 West Wisconsin Ave., Neenah, WI 54956.*

Also from J.J. Keller is the *Metric Manual*, a 362-page looseleaf manual telling how it all began, what to consider when converting and how to convert. Price is \$28.

Metrication: Myths and Realities is the second annual report from the American National Metric Council. Data for the 32-page report was gathered from industry leaders and metric experts throughout the country and reflects the U.S. position on metrication in major sectors of the economy: the automobile industry; the construction industry; education; consumer products and packaging; legislation and regulatory agencies; and many others. The report also includes an interpretation of the Metric Conversion Act of 1975. Price for one to nine copies is \$3 each. Write *ANMC, 1625 Massachusetts Ave, NW, Washington, DC 20036.*

SOFTWARE PATENTS: A POSSIBLE MAYBE

In the latest test case for software patents, the Supreme Court denied a patent to Thomas R. Johnston for his computerized banking program on the grounds that it was obvious to a "person having ordinary skill in the art" of computers and banking. According to software house Applied Data Research, the patent was denied only for this "obvious" software program and therefore patents on nonobvious state of the art programs will have a chance. *Computer Law and Tax Report* goes along with this, but points out that very few application programs will be good candidates for patent. The decision in the Johnston case is the latest stand of the court. Software patents were issued before 1973, when the Benson & Tabbot case set a precedence for considering software a nonpatentable process.

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book reviews

SOFTWARE TOOLS by *Brian W. Kernighan and P.J. Plauger*, Addison-Wesley, Reading, MA. 338 pages, \$8.95, paper.

The authors of this impressive little book stated their philosophy of good programming and incidentally the reason they wrote *Software Tools* in two simple sentences: "Building on the work of others is the only way to make substantial progress in any field. Yet computer programming continues as a cottage industry because programmers insist on reinventing programs for each new application, instead of using what already exists." An advanced text on programming, *Software Tools* is an attempt to start the student off right by showing him how a broad range of pragmatic and versatile programs were built for use as tools. By "tools," the authors mean techniques and aids to make programs work without needless repetition and debugging. Accordingly, the book is arranged not by programming functions (flowcharting, debugging, top-down-techniques, efficiency), but by applications (files, sorting, text patterns, editing, formatting, macro processing). All of their useful and educational tools are written in Ratfor (Rational Fortran), a language the authors say is easy to learn if you know Fortran, Cobol, PL/1, Algol, or Pascal. And, the authors say, all of the tools work. The publisher is apparently comfortable enough with this claim to offer a machine-language version of every program. The larger programs were run on three different machines — IBM System/370, Honeywell Model 6070 and DEC PDP-11. The authors believe that the student can best learn good habits by studying successful real-world programs. If you agree with this theory, you'll probably find this book an excellent investment of \$9.

— Ernst Barlach

ADVANCES IN COMPUTER COMMUNICATIONS edited by *Wesley W. Chu*, Artech House, Inc., Dedham, MA. 607 pages, \$25.00, paper.

In this second edition the editor has added 12 new papers on such topics as data link control procedure, flow control, interprocess communications, network performance simulation and measurement, distributed data bases, computer cost and communications cost trends, security in the computer communications environment, and economic and political issues in networking. Dr. Chu has also added many new references to articles and books. As in the first edition, articles are verbatim reprints, mostly from publications of the IEEE, AFIPS and ACM. General topic headings in this collection are traffic characteristics, error control techniques, modems, statistical multiplexing, packet switching via satellites, loop systems, examples of computer communications networks, network design considerations, communications processors for store-and-forward networks, interprocess communications, distributed data base design considerations, network reliability, network security, common carrier facilities and services, and social and legal issues.

— Ernst Barlach

1. The Programmer's COBOL

By *Marjorie Berk*. Helps the COBOL programmer quickly find information to prepare a program for a computer. Features easy use and direct application of its comprehensive treatment of the COBOL computer language. 250 pp., \$22.50

2. Computer-Assisted Planning Systems

By *James B. Boulden*. A clear, thoroughly researched perspective on how computer-assisted planning systems can and should perform in operations ranging from strategic planning and budgeting to market forecasting and pricing and buying decisions. 228 pp., \$12.95

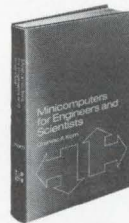


3. The Programmer's RPG

By *Rochelle Gershon*. Defines and discusses the RPG language, provides a highly detailed presentation of each language element, and presents many sample programs illustrating the definitions and rules. 443 pp., \$6.95

4. Management Information Systems Handbook

By *W. Hartman, H. Matthes, and A. Proeme*. A step-by-step approach to the preparation of a computerized data processing system for business organizations utilizing the ARDI approach (Analysis—Requirements Determination—Design and Development—Implementation and Evaluation). 750 pp., \$37.80



5. Minicomputers for Engineers and Scientists

By *Granino Korn*. This book will give anyone who is using or planning to use minicomputers a full understanding of the units now available and of how their possibilities may be more completely realized. Also covers peripherals, assembly language, etc. 352 pp., \$23.45

6. Managing the EDP Function

By *A. Ditri, J. Shaw, and W. Atkins*. Explains how EDP functions can be directed and controlled by any responsible executive—even those who have no technical knowledge of computers. An indispensable reference for planning, resource allocation, implementation, and control of computer operations within an organization. 228 pp., \$21.35

7. Materials Requirements Planning

By *Joseph Orlicky*. The new way of life in production and inventory management. Maps out fundamental concepts of the MRP system; describes the system elements and implementation alternatives, discusses input and use of outputs, applicability of techniques, and impact on theory and practice of production and inventory control. 292 pp., \$12.95



8. Condensed Computer Encyclopedia

By *P. Jordain*. Arranged alphabetically, this work explains the array of terms, items, technical details, interpretive languages, etc. connected with computers. Numerous examples, detailed essays, and precise, accurate explanations sweep away the mystery surrounding computers. 448 pp., \$19.95

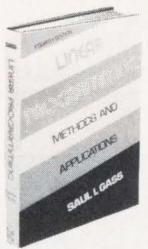
9. A Guide for Software Documentation

By *Dorothy Walsh*. Clearly sets forth the steps and content for the preparation of documentation for a variety of computer situations—and shows just which topics should be covered. Documentation models included are product specification, operator's guide, internal logic manual, subprogram, program library, assembly language, etc. 158 pp., \$18.75

COMPUTER BOOKS FROM MCGRAW-HILL

10. Managing Computer System Projects

By John Shaw and William Atkins. Presents and describes—in working detail—a methodology for the planning, development, and implementation of computer-based systems. Emphasis is on the practical—what to do and why—using proven management techniques. 304 pp., \$22.95



11. Linear Programming

Methods and Applications, Fourth Edition

By Saul I. Gass. This revised fourth edition retains the basic aims of teaching the reader to recognize potential problems, to formulate them as linear programming models, to use the proper computational techniques in solving them, and to understand the mathematical aspects that tie together these elements of linear programming. 358 pp., \$18.50

12. Principles of Data Communication

By R. Lucky, J. Salz and E. Weldon. A reference book of timely information on such matters as theoretical performance bounds, adaptive equalization, optimum pulse transmission systems, and error control. 198 pp., \$22.00

13. Microprocessors

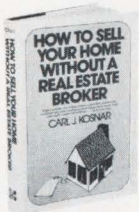
Edited by Laurence Altman, Electronics Book Series. A general overview of the technology of microprocessors. Includes analyses of specific systems, design innovations, and practical applications in a collection of recent articles from *Electronics* magazine. Generously illustrated with diagrams, photographs, charts, and tables, it is a valuable reference for designers and engineers. 154 pp., \$13.50

14. The Art of Writing Effective Letters

By Rosemary T. Fruehling and Sharon Bouchard. Lively and conversational, this book explains the how-to of writing persuasive business and personal letters. Covers requests, acknowledgments, special replies, goodwill, sales, claim and adjustment, credit and collection, job application, reports—in short—the gamut of business correspondence. 258 pp., \$7.95

15. How to Sell Your Home Without A Real Estate Broker

By Carl J. Kosnar. A guide for selling all types of real estate—single-family home, condominium, cooperative apartment, commercial property, vacant land. Offers full professional guidance. Anticipates questions sellers ask about price, negotiating procedures, mortgage money, tax and legal matters. Includes forms, aids, sample contracts, payment tables, and glossary of terms. 224 pp., \$10.95



16. Computer System Performance

By Herbert Hellerman and Thomas F. Conroy. Performance, the speed, reliability and convenience of a computer system, is examined in this self-contained treatment of many important issues in computer science. By focusing attention on system goals, this book helps develop essential skills and provides timely examples for professionals in computer systems. 416 pp., \$19.50

17. Boss Psychology: Help Your Boss Make You a Success

By Charles C. Vance. A book for anyone who works for someone. Designed to help employees work *with* rather than against management to further their own best interests. Full of practical suggestions for handling the boss and moving ahead. 200 pp., \$8.95



18. How to Cut Costs and Improve Service of Your Telephone, Telex, TWX and Other Telecommunications

By Frank K. Griesinger. A money-saving manual covering every conceivable technique for achieving better telecommunications at less cost. 288 pp., \$14.50

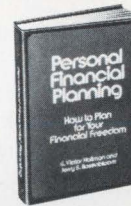
19. Operating Systems



By Stuart E. Madnick and John J. Donovan. Reporting on the latest work done in operating systems design, the authors cover the design, analysis, and implementation of such systems from a conceptual framework based on resource management. A complete and practical design of an operating system is featured, and there are many case studies. 640 pp., \$19.50

20. Microprocessor Applications Manual

By Motorola Semiconductor Products, Inc. An authoritative volume providing detailed applications information for a representative general purpose MPU. Assumes no prior MPU knowledge on the readers part, and covers all the systems phases, exploring architecture, the instruction set, addressing modes, interrupt structure, and other features. 698 pp., \$25.00



21. Personal Financial Planning

By G. V. Hallman and Jerry S. Rosenbloom. The first book to emphasize the all-important function of planning one's personal finances, Mindful of the economic belt-tightening everyone is currently going through, the authors approach the subject with a view towards helping the reader set realistic objectives. 416 pp., \$9.95

22. Introduction to Management Information Systems

By Gordon B. Davis. Provides an understanding of the conceptual foundations supporting the analysis, design, and use of computer-based management information systems. While emphasizing conceptual foundations and structure of MIS, other topics relating to development, evaluation, and implications are also discussed. 492 pp., \$17.50

23. Technology Mathematics Handbook

By Jan J. Tuma. A convenient reference for all types of engineers and technologists. Offers definitions, formulas, tables, and examples of elementary and intermediate mathematics with emphasis on technological applications. Individual sections on arithmetic, algebra, geometry, trigonometry, analytic geometry, differential and integral calculus, series, vector and matrix algebra, and numerical procedures. 300 schematic drawings and illustrations. 352 pp., \$15.95

24. The Complete Bond Book

A Guide to All Types of Fixed-income Securities

By David M. Darst. For everyone who wants to make money and improve investment returns, here is clear, detailed information on how to analyze, purchase, and sell U.S. government and Federal Agency securities, corporate bonds and preferred stocks, tax-exempt securities, short-term money market instruments, and all other types of fixed-income securities. 336 pp., \$12.95

25. The Stock Options Manual

By Gary L. Gastineau. The first book to explain in easy-to-understand terms the characteristics and tax treatment of options as well as the principles that stand behind the rational evaluation of an option contract. Concentrates on the true key to the intelligent use of options. 262 pp., \$12.95



26. Digital Computer User's Handbook

By M. Klerer and A. Korn. A group of experts give guidance in subjects such as list processing, sorting and merging, interpolation and curve fitting, symbolic logic, linear and non-linear programming, commercial data processing, information retrieval, and scheduling and inventory control. 550 pp., \$32.95

SIRVESS WITH A SMILE

Innovex Corp. has entered into an agreement with Sirvess, Inc. (Saddlebrook, NJ) whereby Sirvess will provide third-party maintenance on Innovex Corp.'s diskette drives and subsystems. Innovex Marketing Vice President Michael P. Keating said, "this now provides nationwide support to our line of add-on diskette memory subsystems plus enhances our OEM customers own field service groups."

LARGEST DOLLAR GAIN FOR NATIONAL SEMI

Charles E. Sporck, President of National Semiconductor Corp., told a group of security analysts recently that he expects that National sales for its 1976 fiscal year ended May 31 will be in excess of \$320,000,000. He also predicted that sales for fiscal 1977 will show the largest dollar gain in the company's history. While declining to specifically comment on net earnings, Sporck stated that the company's fourth fiscal quarter profits will improve over the company's third fiscal quarter which totaled \$3,555,000 or \$.27 per share. He added that he expects company profit margins to continue to improve during the first fiscal quarter.

IT'S ALL IN THE NAME

Data Disc, Inc. has changed its name to Amcomp, Inc. According to President James Woo, the name change "is part of a plan which was started 8 months ago. At that time a new management team joined Data Disc to build a new company on a sound and solid basis with the purpose of becoming a leading full-service supplier of OEM peripherals and systems. The selection of our new name signals the final phase - the company has been restructured and the foundation laid for long term growth and profitability."

CRAMER DISTRIBUTES RAYTHEON'S SEMICONDUCTORS

Raytheon Semiconductor Division has become a major semiconductor line with the national Cramer Electronics distribution network. Cramer will be stocking product in all 25 locations, with inventory being controlled regionally. All Cramer locations are equipped with a CRT terminal that can scan all stocking locations throughout the country instantly.

WU TO MAINTAIN MODEMS

Tele-Dynamics (Ft. Washington, PA) has signed a nationwide maintenance

agreement with Western Union. According to John D. Familetta, Tele-Dynamics Vice President, the new arrangement will provide his company's modem customers with maintenance service from one of the most experienced organizations in the world. Tele-Dynamics markets a line of modems which are compatible with those leased by the Bell System.

PERTEC AND UNIVAC SIGN OEM CONTRACT

A major OEM agreement covering future acquisition of Perotec disk drives by Sperry Univac specifies that Sperry may purchase multiple quantities of D3000 series disk drives during the next five years, which could possibly result in purchases in excess of \$15,000,000.

EARNINGS (LOSSES)

Ampex Corp. announced an increase of 89 percent over the prior year in pre-tax earnings from continuing operations exclusive of non-recurring items. For the fiscal year ending May 1, 1976, earnings rose from \$5.0 million in fiscal 1975 to \$9.4 million in fiscal 1976. Earnings for fiscal year 1976 were \$8.0 million after giving effect to an extraordinary charge of \$2.25 million for the proposed settlement of the class action suits. Net earnings for the prior fiscal year were \$10.3 million and included a non-recurring pre-tax gain of \$13 million as the result of a settlement with IBM.

General Automation Inc. reported third quarter (ended May 1, 1976) sales of \$14,518,000, compared with \$13,178,000 for the same period last year. Operations during the quarter resulted in a net loss of \$1,425,000 compared with a net loss of \$660,000 a year ago. Sales for the nine month period amounted to \$47,804,000 compared with \$41,392,000 for the previous year.

Mohawk Data Sciences Corp. reported net income for the fiscal year ended April 30, 1976 of \$13,560,000 compared with a net loss for the previous year of \$21,677,000. This was the first profitable year for MDS since 1970. Net income from continuing operations was \$4,142,000, including the utilization of foreign net operating loss carryforwards of \$2,037,000. In the prior year, the Company had sustained a net loss from continuing operations of \$21,009,000. The company realized extraordinary income in the current fiscal year of \$9,418,000 resulting from its Debenture Exchange Offer.

On-Line Systems Inc. reported revenues of \$3,662,925 for the three months ended April 30, 1976, up from \$2,400,176 a year ago. Net income for the period was \$356,251 as compared to \$82,599 in the comparable period last year.

Standard Microsystems Corp. (Hauppauge, NY) reported 3-months (ended May 31, 1976) sales of \$968,053 compared to \$596,491 in 1975. Net income was \$114,256 after a \$51,000 tax loss carryover. In the similar period last year net income was \$15,822.

Digital Computer Controls announced a net income for the first fiscal quarter ended May 31, 1976, was \$495,725, or \$.32 per common share outstanding, compared to year-ago earnings of \$89,462 or \$.06 per share. Consolidated sales were approximately double those of a year earlier, reaching \$4,846,149, compared to \$2,339,393.

Scan-Data Corp. reported revenues for the first quarter ending March 31 of \$3,287,408 compared with \$2,476,446 for the year-earlier period. Net income for the period was \$16,528, or \$.01 per share, compared with \$76,133, or \$.04 per share a year ago.

Decision Data Computer Corp. (Horsham, PA) reported a net loss of \$8,417,000, or \$2.25 per share, for fiscal 1975, of which approximately \$7,500,000 was of a non-recurring nature, reflecting adjustments in depreciation rates, inventory reserves and other write-offs. The loss for fiscal year 1975 compared with a net income of \$1,511,000, or \$.40 per share, for fiscal 1974. Revenues for 1975 were \$39,679,000 compared to \$40,607,000 in 1974.



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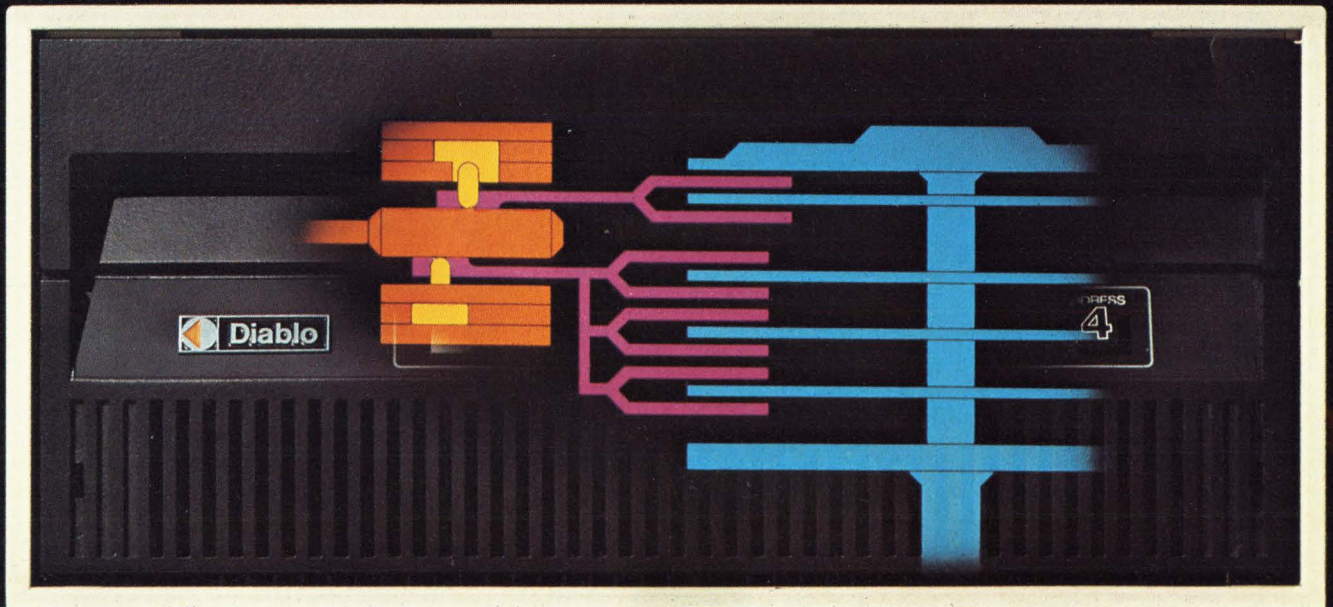
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CIA SAYS SBS APPLICATION VIOLATES FCC ORDERS

The Computer Industry Association filed a petition with the FCC requesting a rejection of the domsat application of Satellite Business Systems, a joint venture by IBM, Comsat General, and Aetna Life to enter the domestic satellite communications market. The grounds for the CIA petition are that the application as submitted and amended still does not comply with the Commission's Memorandum Opinion and Order of February 6, 1975.

In its filing, the CIA notes that its main point of contention with the SBS application is that it fails to set forth detailed communications and equipment interconnection arrangements as ordered by the FCC. CIA's petition states that SBS's effort to respond to FCC orders regarding interconnection policies and practices is done so "only in the most superficial manner."

Furthermore, CIA points out, the SBS application fails to differentiate between communications interfaces — for which there exist established industry standards, and computer terminal and equipment standards — for which there exist no established standards. "In fact," the filing states, "it is this lack of computer interface standards which has contributed to the rash of current antitrust litigations against IBM." The CIA position continues, "Since it is IBM's participation in this venture that has caused the Commission to issue the order requiring detailed interconnection arrangement disclosures in the first place, SBS must therefore abide by the Commission's order . . ."

Although SBS admits that most existing terminal equipment will require some modification to effectively use satellite transmission, CIA notes, its failure to specify details gives IBM — the presumable developer of the system — a certain lead time advantage over the other equipment suppliers. "Moreover," the filing charges, "SBS's mere promise that interconnection arrangements will be offered through tariffs on non-discriminatory terms and conditions is of little comfort to manufacturers who realize that interconnection charges for maintaining their equipment on IBM computers may be prohibitively expensive though they may still be 'non-discriminatory'."

With regard to disclosure of computer interfaces, the CIA paper reminds the FCC that SBS makes no effort to provide information on those interfaces other than its general promise to make the system "compatible with as broad

a spectrum of terminal equipment as possible."

Another area in which the CIA contends the SBS application falls short of FCC mandates is the stipulation that IBM and SBS refrain from selling or promoting each other's products or services. While the FCC's order made it abundantly clear that it would not tolerate any bundled marketing efforts, the CIA petition points out, the SBS application talks in terms of "concluding" as opposed to selling or promoting affiliate product services. The CIA filing states, "It is an inarguable conclusion that the semantic differences between the Commission's order and the instant application leave open the possibility for abuse. No keen intellect is needed to see that *concluding a transaction* is not the same as *promoting products or services . . .*" and the application must thus be amended to reflect the precise meaning of the FCC order.

The CIA concludes that the SBS application and amendments should be "rejected on the grounds that they materially fail to comply with express Commission orders." The filing states that the Commission's treatment of this issue to date reveals that "there is no room for a flexible interpretation" of its requirements.

Copies of the complete 25-page petition can be obtained from CIA offices at 1911 N. Fort Meyer Drive, Rosslyn, VA 22209 (703/524-1360).

COURT LIFTS STAY ON FCC TERMINAL REGISTRATION PROGRAM

The United States Court of Appeals for the 4th Circuit, Richmond, VA, has vacated its stay of the Federal Communications Commission's order authorizing general direct connection of customer-owned data and ancillary equipment to the public switched telephone network. The stay was issued on April 29, 1976 in response to claims by AT&T and others of irreparable economic harm which would result from the FCC program. The Court's order, a unanimous decision by a three judge panel, allows the FCC to proceed with its registration program for interconnection of customer-provided data and ancillary equipment to the public switched telephone network which the FCC initially ordered on November 7, 1975 (Docket 19528). The stay will, however, remain in effect for extension telephones, key telephone systems and PBX equipment.

The oral argument resulted from petitions to the Court for reconsideration of the stay order by the Depart-

ment of Justice and the FCC, supported vigorously by briefs from a number of interveners, including the Independent Data Communications Manufacturers Association (IDCMA). The basis of the argument of the interveners was that the National Association of Regulatory Utilities Commission (NARUC) and the Federal-State Joint Board had previously concluded that the registration program as applied to data and ancillary equipment could not have adverse impact on the users of basic telephone service. In fact, reports from those organizations recognized that the public interest would be best served by such a program.

NETWORK NEWS

Telenet Communications Corp. has filed with the FCC an application to provide a public packet-switched data communications service between the United States and the United Kingdom. Telenet will interconnect its network with packet-switching facilities operated in the United Kingdom by the British Post Office to provide overseas communications for computers and terminals on a demand basis. Rates will be based on the volume of data transferred at the proposed rate of \$.01 per packet. Typical overseas charges for interactive and transaction-oriented computer communications are expected to range from \$3.00 to \$12.00 an hour. Overseas traffic will be channeled through Telenet switching centers in Boston, MA and Washington, DC via two 50-kilobit Intelsat satellite circuits. Separate earth stations and Atlantic basin satellites will be used to provide alternate communications paths to the U.K. Although Telenet pioneered the use of packet switching for commercial users, the company is a relative newcomer among domestic common carriers, having begun operation in August 1975. The transatlantic competition includes three large and well-established firms: RCA Global Communications, ITT World Communications and Western Union International

General Electric Information Services has announced a restructuring of its Mark III Foreground Service pricing. According to GE, two new productivity features will be introduced: Metro Access and Custom Usage Plans. Additionally, certain Foreground Service pricing elements will increase approximately 10 percent. The new Metro Access capability will be available in connection with full-duplex, 1200 baud service, 4800-baud High Speed Service, and Telephone Information Processing Service, and will permit savings of up

to 50 percent in data transmission costs, according to GE. Metro Access will initially be available in New York, Chicago, Washington, Cleveland and Los Angeles. GE said each of the four new Custom Usage Plans "is designed to enable users to obtain price discounts geared to the level and pattern of their Mark III Foreground Service usage. Savings of up to 60 percent will be available to customers during non-prime time periods under these plans." The price restructuring will not affect customers' use of Mark III vs Background Service or Mark III GCOS Background Service.

TELENET SETS RATES FOR NEW SERVICE POINTS

Telenet Communications Corp. announced rates for data communications service in new cities served by its packet network and a network-wide reduction in access rates for large volume users. In a revised tariff to be filed with the FCC, each of Telenet's 45 presently-installed central offices will be classified as a high, medium or low-density point, with corresponding access charges. Traffic charges, which are based on the volume of data sent, independent of distance, will remain unchanged at \$.60 a kilopacket for all rate classifications. Basic access charges for high and medium-density cities (formerly classified as low-density) will continue to be \$1.40 and \$2.40 per hour, respectively, for use of public dial-in network access ports. Similar charges for a new classification of low-density cities will be \$4.80 per hour. Access charges will drop to \$.70 an hour for all central offices after an initial period of usage each month. Volume rates will take effect in high-density cities after 1200 hours in a given month; in medium-density cities at 500 hours; and in low-density cities, after 200 hours. Roger W. Goetz, vice president for marketing, pointed out that Telenet's sliding rate structure provides substantial communications savings for nearly all classes of users, comparing favorably with alternatives such as WATS line service at approximately \$12.00 per hour and the cost of multiplexer or concentrator networks, often used in high traffic areas, which is typically several dollars an hour.

TYMSHARE COMES OUT

Although Tymshare has operated an underground value-added network (VAN) for the past six years, it always said it was a private packet-switching network, selling only its excess network time for non-time sharing services. Telenet — the competitor — never cared

much for the arrangement and filed a complaint with the FCC.

Working around the complaints, Tymshare has formed a wholly-owned subsidiary — Tymnet, Inc. — which has applied for FCC authorization to operate an interstate VAN. Tymnet was also the name of the original packet-switching network developed by Tymshare in 1969 to provide time sharing services. The network now serves 61 U.S. cities; the FCC applications asks for authorization of 105 cities by 1979. Initially, Tymnet services will include low and medium-speed lines, although the application also asks for authorization to offer services at any rate of speed "which is economically and technically feasible" in the future.

Tymnet leases the transmission facilities from existing carriers and has no plans to construct its own facilities. It has its own specially-programmed communications processors.

TELEMONEY — CONTROL DATA'S EFT SERVICE

Control Data will offer data services in the Electronic Funds Transfer (EFT) area. Initial offerings, which will be

available late this year, are credit card authorization, check verification/guarantee services, and a limited cash card funds transfer service. A cash card service, complete with local/national interchange and settlement information, is planned for the latter part of 1977.

The new EFT services, called TeleMoney, will be marketed in the United States to financial institutions which will in turn sell the services to their retail customers. TeleMoney will allow the merchant to get authorizations on Master Charge and BankAmericard transactions through a tie-in to their national authorization network that accesses data banks of credit information. Verification of other major credit cards below the merchant's floor limit is also provided from the same point-of-sale terminal.

TeleMoney offers two approaches for check guarantee. The check verification/guarantee service can access a file of negative information gathered from the merchants who subscribe to the service. The TeleMoney service also will make it possible for participating financial institutions to determine check authorization.

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TERMINALS

Beehive has two new terminals: the user programmable B500 and the inexpensive B100. The Intel 8080-based B500 features an expandable memory to 56K bytes, data transmission rates to 19,200 bps, detachable keyboard with numeric pad and 2000-character display. Price



Beehive's B500 Programmable Terminal

for the B500 is \$2695 with OEM discounts available. For \$1495, there's the B100 with transmission rates to 19,200 bps, RS-232 or current loop interface and editing functions. The terminal has a 12-inch, 960-character display or optional 1920-character display. Contact *Beehive Medical Electronics, Inc., Box 25668, Salt Lake City, Utah 84125.*

Tymshare, Inc. has announced their Model 125 "super-portable" data

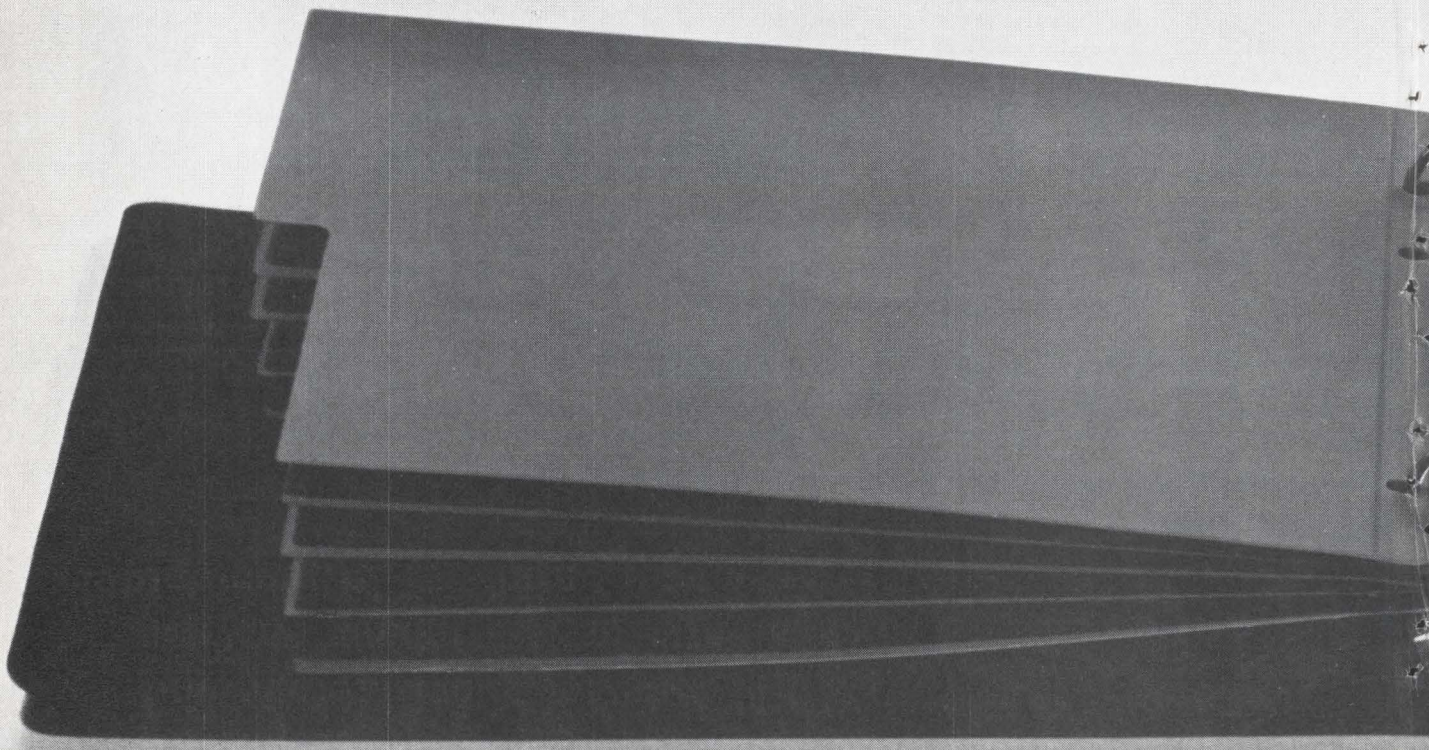
terminal that weighs only 13-1/2 lbs. including coupler and carrying case. It requires only a standard telephone and electrical outlet for fully portable KSR operation. Features include silent printing, color-coded keyboard, integrated 13-key numeric pad, and alternate 30 or 10 cps operation. Sale price: \$2210; rental as low as \$100/month. Contact *Tymshare, 20705 Valley Green Dr., Cupertino, CA 95014.*

An interactive computer terminal that produces high-quality print at speeds up to 45 characters per second was demonstrated by **Xerox Corp.** at the NCC. "The new micro-processor-driven Xerox 1700 terminal, which uses the Diablo Hy-Type II printer mechanism, provides users with a substantial improvement in operating speed and costs about 25 percent less than the Xerox 3010 terminal it replaces," said Robert V. Adams, vice president, computer printing operations. The typewriter-paired keyboard provides direct compatibility for APL applications, placing the special charac-

ters in industry-standard locations for use with an APL print wheel. In the graphics mode, the new terminal has special capabilities for drawing charts and graphs. Printing and carriage positioning are divorced in this mode, allowing either the operator or the host computer to adjust spacing incrementally by 1/60-inch horizontally and 1/48-inch vertically. The terminal operates at 110, 150 and 300 baud asynchronously, making it compatible with Bell's 103A or 113A modems or their equivalents. On these systems it will perform in KSR 33/35 mode, as well as in replacement or other terminals being used for more advanced text-processing systems and APL implementation.

The new terminal is also available without a keyboard for use as a receive-only printer. Both models are available for purchase or lease on a 30-day delivery schedule. The Xerox 1700 is priced at \$2981 for purchase or \$130 per month on a 1-year lease. The Xerox 1710 lists at \$2620 purchase or \$121 on a 1-year lease. Quantity discounts are

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also available on purchased machines. Contact *Xerox Corp., 701 South Aviation Blvd., El Segundo, CA 90245.*

Featuring interchangeable, dual-font character sets (upper and lower case) the newest member of the MINITERM lightweight data terminal family from **Computer Devices, Inc.** is the Model 1201 Receive-Only data terminal. Small physical size only 14"x12.5"x4.5" and weighing only 13 pounds including paper, the Model 1201 is hard-wire com-



Computer Device's Model 1201

patible with all major CRT's, mini-computers and central processors through RS-232 interface. Standard features include printing speeds up to 30 characters per second; parallel

interface; 96 characters (upper and lower case) with true underscore in USASCII code; off-line line feed and carriage return; high speed paper advance; and power-on, online operation, error and audible bell indicators. Several options are available such as RS-232C serial interface; 2 or 4-wire 20 milliamp current loop; TTL serial; selectable transmission rate of 110, 150, and 300 baud (a special buffer option increases this rate to 1200 baud); and a page buffer memory of 2040 or 4080 characters. Built-in acoustic couplers, internal modems, and export (CCITT) modems are also available. Contact *Computer Devices, 9 Ray Ave., Burlington, MA 01803.*

An expanded solid-state keyboard featuring both numeric pad and lower-case ASCII alpha characters is designed to simplify data entry for users of **Lear Siegler's** new ADM-1A video display terminal. This latest member of the ADM-1 Series of terminals has a numeric pad with period, comma, plus and minus signs in concert with an alpha board which has

been expanded to 138 characters, including upper-and lower-case letters, punctuation and control keys, according to Tom Viggers, marketing manager for the Data Products Group of **Lear Siegler's** Electronic Instrumentation Division. The ADM-1A numeric pad is positioned adjacent to and immediately to the right of the standard keyboard to afford natural operator hand movement and facilitate numeric data entry. Keys are arranged in standard calculator keypad positions. In addition to the new lower-case keys, the alpha keyboard has a key for locking the keyboard into upper-case letters. Additional features include a display format of 960 characters arranged as 80 characters per line by 12 lines, with optional placement of 1920 characters in 24 lines. The 12-inch P4 white phosphor etched faceplate has a 5x7 dot matrix, 0.19 inches high and 0.125 inches wide. The basic ADM-1A is priced at \$1850 in single quantity. OEM discounts are available. Contact *Lear Siegler, Inc., EID/Data Products, 714 North Brookhurst St., Anaheim, CA 92803.*

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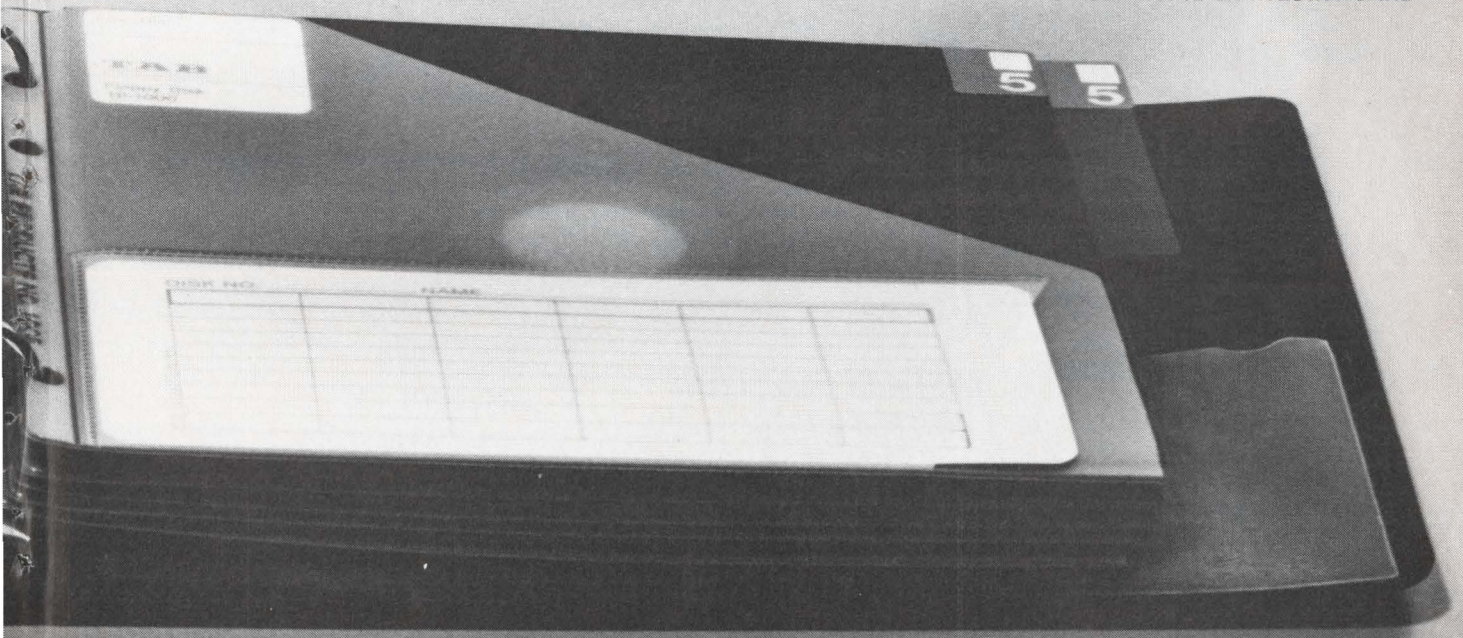
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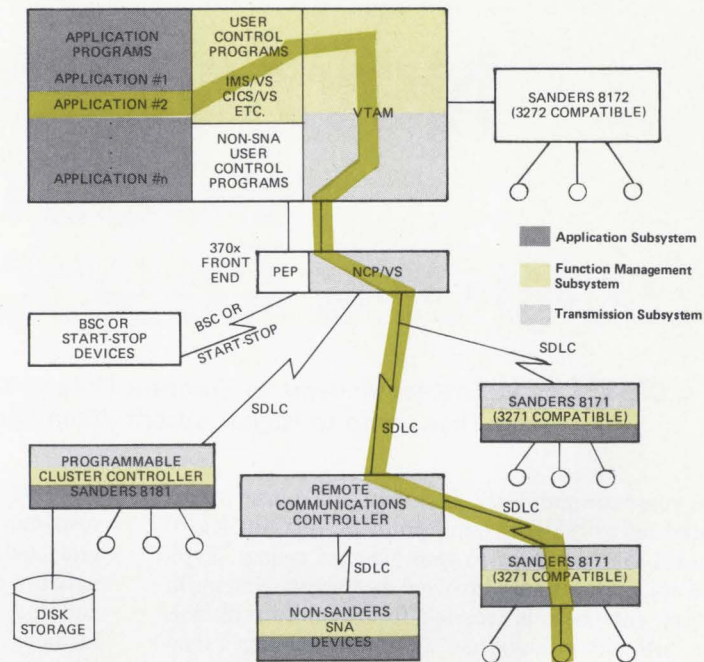
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SANDERS DEMONSTRATES SNA

With its 8170 terminals, Sanders Data Systems (Nashua, NH) recently demonstrated IBM's System Network Architecture, which uses SDLC (Synchronous Data Link Control). The 8170 terminal systems were programmed to emulate the SNA version of IBM's 3270 Display System. One of the advantages of SNA and SDLC is the increased throughput over the BSC (binary synchronous) architecture and line discipline. To optimize this throughput, Sanders had to decide which of the SNA protocols would be hardwired in the terminals and which would be programmed. SDLC protocols will be hardwired in the production versions of the 8170 SNA model. (See Fig. 1 for Sanders' prototype SNA configuration.)

Increased throughput is possible with SNA because there is one uniform architecture, regardless of the terminal or application. Instead of user programmers having to program "handshake conventions" and communications procedures, system software (VTAM and NCP/



VS) performs the supervisory, control and communication error handling functions.

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Sanders SNA 8170 terminal are scheduled for January, 1977. Purchase price for an SNA option for an average size cluster is \$1000.

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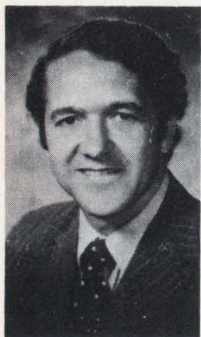
New Modems Boost Network Response Time

A Clever Design Enables Modems to Transmit Data at Medium Speeds During Equalization, and Then Jump to Higher Speeds When Equalization is Completed

For several years communications systems users have implemented large networks with multipoint circuits, in lieu of multiple point-to-point links to gain big cost savings. Typically, these applications have involved interactive systems in which a large data base is accessed from remote terminals and where both the inbound and outbound messages tend to be relatively short. A classic example is the airline reservation systems, in which multiple dispersed terminals periodically access the system data base to determine seat availability, flight information, etc. Another example is that of banking systems, in which postings for deposits and withdrawals, etc. are made on line from teller terminals at branch locations. A major requirement for all such systems of this type is that each terminal must use only a very small fraction of time to complete a transaction. If this requirement is met, then many terminals can utilize the same communications circuit on an interleaved basis, while to each operator it appears as if a private connection exists to the central processor.

Two major figures of merit for such interactive multipoint systems are response time and transaction rate. Response time refers to the delay between the time the operator presses an "Enter" key (for a previously typed-in inquiry) and the time the response begins to appear back at the terminal. Psychologists and behaviorists have shown that an operator can tolerate a response time up to about three or four seconds before irritation and frustration are encountered.¹ The transaction rate relates to the traffic intensity, i.e., the volume of inquiries and replies that must be carried in the peak period.

¹ Systems Analysis for Data Transmission, James Martin, Prentice-Hall, Inc., 1972, pp 61-73



RALPH W. LOWRY received a BSEE degree from Brown University and has subsequently held various engineering positions in the computer industry with IBM, Ampex, and Univac performing design and development activities on magnetic memory systems. After receiving an MBA degree, Mr. Lowry held a product management position in the semiconductor industry and later was involved in planning and marketing functions as Manager of Market Analysis for the Computer Control Division of Honeywell Information Systems. Mr. Lowry joined Codex in 1973 as Product Manager for modems. In 1976 he was promoted to Director of Product Marketing.

Good multipoint system design requires meeting the response time objectives while supporting the transaction rate; and of course, doing so at least cost. The principal network characteristic which determines the response time and the transaction rate is the transmission process. This includes factors such as modem bit rate, line protocol, line turnaround, etc. Obviously, a system with a slow transmission process necessarily requires a longer time to service each terminal inquiry. Thus, as the system sequentially polls each terminal, the delay between successive terminal polls is greater causing the response time to lengthen. Standard solutions for this kind of problem include using a faster modem, or reducing the number of terminals serviced by the multipoint line. In most cases the use of a higher speed modem will be a less costly solution than the spreading of terminals across more circuits.

FORCING FACTORS

To explore more thoroughly the factors which affect multipoint system performance, we can examine a normal system as shown in Fig. 1. Here we have multipoint lines emanating from a communications control unit (CCU) with each line going to a number of so-called drops. These drops may consist of an individual terminal, or a terminal cluster under control of a terminal control unit. An example of the clustered approach would be the IBM 3270 system, with CRTs and keyboards being used for interactive real time operation. In the system of Fig. 1, however, let us assume a single terminal per drop. Note also that multipointed systems are usually operated with the CCU modem's carrier on at all times, and with the terminal modems in a controlled (on-off) carrier mode. In operation, the CCU progresses through a polling list, sending a poll out to each successive terminal. As a terminal recognizes its address in the poll message it turns on its modem and sends a return message back to the CCU. This return message can be merely an acknowledgement that the terminal has recognized it is being polled but has no input pending, or it could be a complete input message if the terminal has something to send. In the case where the no-traffic acknowledgement is sent, the CCU proceeds to poll the next terminal in the list with minimum delay. If an input message is received, the CCU sends a response message to the terminal before going on to the next terminal in the polling list.

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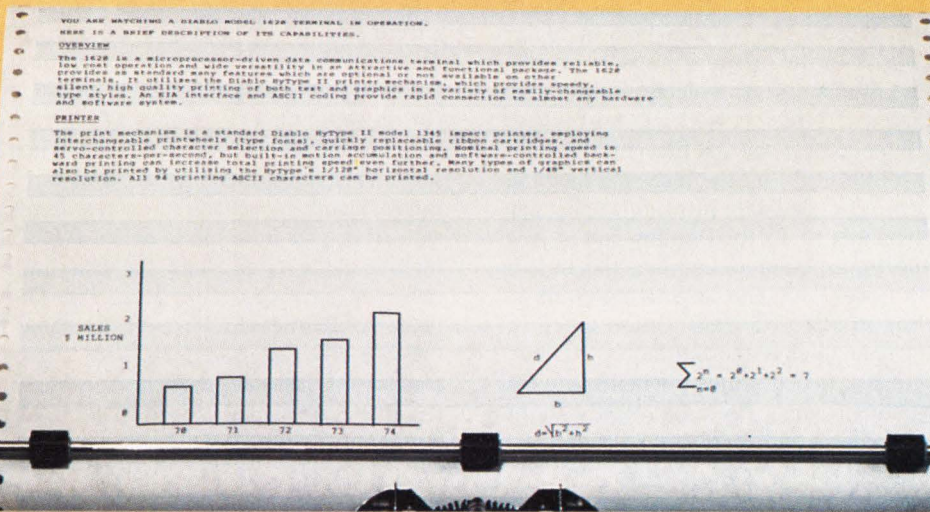
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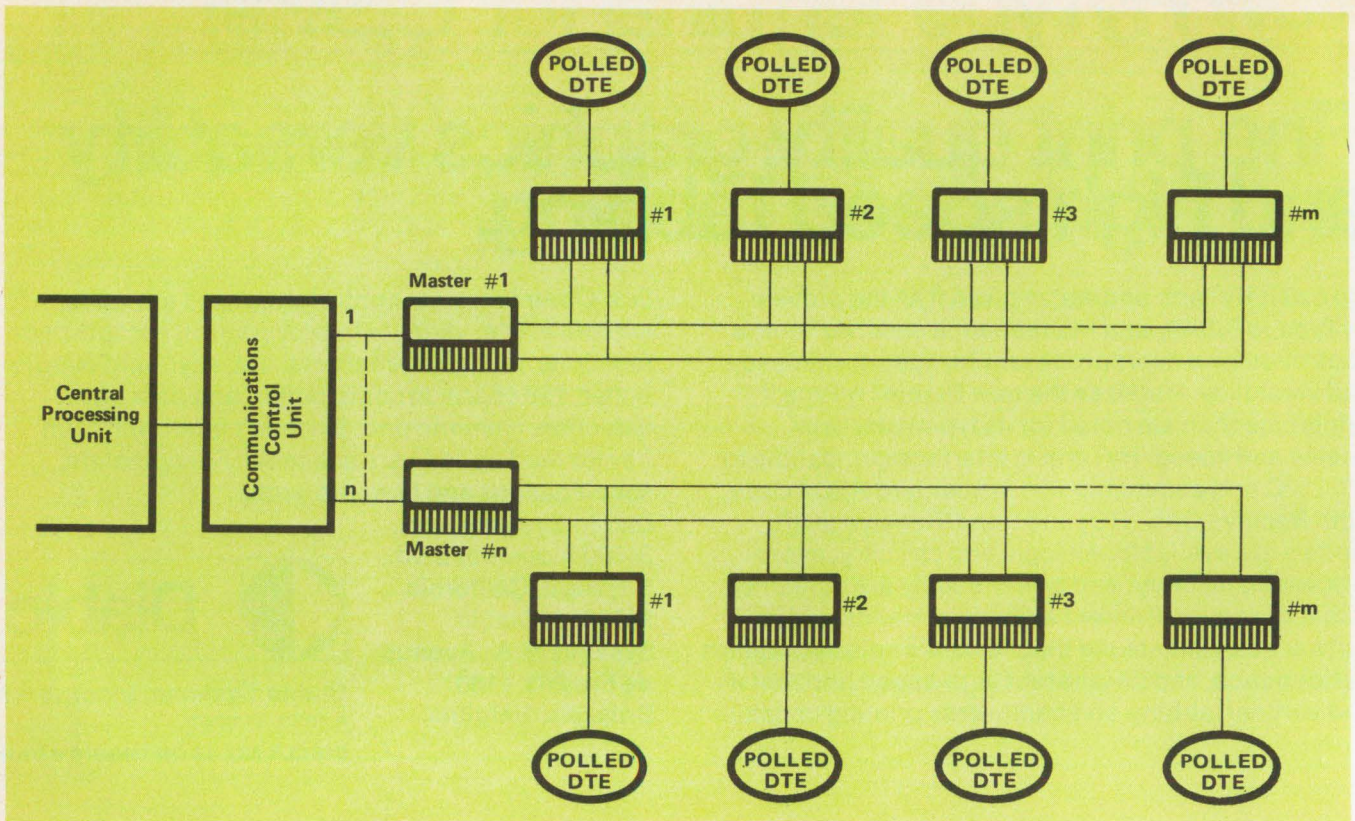


Fig. 1. Typical Multipoint System

Now, to get a more thorough idea of how the efficiency of the transmission process is determined we must look at the detailed breakdown of both the outgoing and incoming messages as shown in Fig. 2. In the outgoing message or poll, delay d_1 represents the modem internal delay. That is, the delay that would be seen if modems were placed back to back and the time difference between the first incoming bit is compared to the first bit output by the receiving modem. Depending upon modem types and data rates, this delay can vary from a few milliseconds to 15 to 20 milliseconds. The delay d_2 represents the transmission delay, i.e., the time it takes for the signal to travel from the originating point to the receiving point. For an effective transmission speed of about 100,000 miles/second, this is approximately 10 msec per 1000 miles. Obviously, this becomes insignificant for short distances. The polling message itself is typically about eight characters in length, plus two to four sync characters to synchronize the remote terminal's receive circuitry.

DELAY FACTORS

For the return message, we see three additional delay factors. First, d_0 represents the terminal delay, or that time from recognizing a poll until a response is initiated. Typically this is very small if no message is to be transmitted, but may be on the order of 100 msec when a message is to be sent. This is followed by d_1 and d_2 which are the same internal and transmission delays as seen on the outgoing side. Then, we have the so-called RTS/CTS delay. Since the remote modems all share the same inbound channel, only one may have carrier on at a time. Thus, as each terminal raises its Request-to-Send (RTS) signal to initiate a return message, the associated modem turns on its carrier. The central site (master) modem must have time to recognize the incoming signal, adjust its internal timing, and, if it is automatically equalized, it must adapt to the incoming signal's characteristics. Depending on the type of modem used

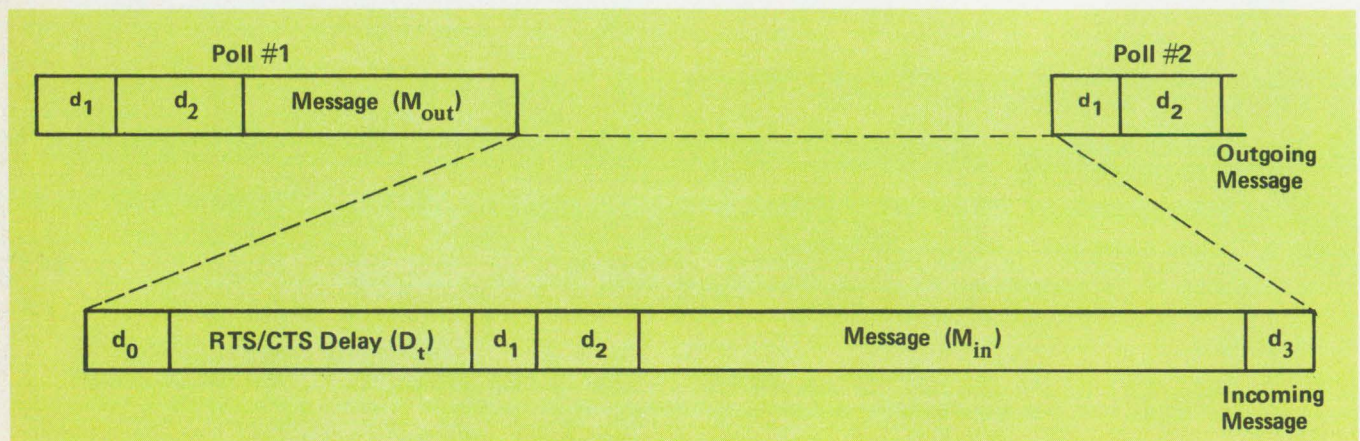


Fig. 2. Typical Inbound/Outbound Multipoint Message Format

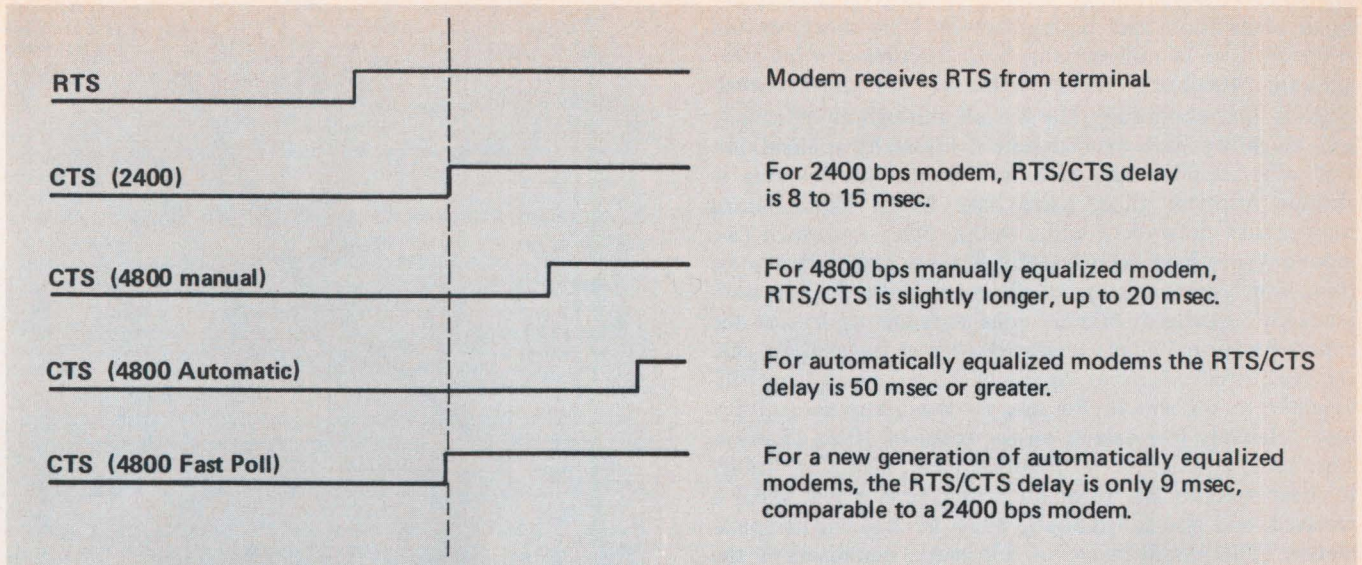


Fig. 3. Typical RTS/CTS Delays

and the speed involved, this delay can vary from 5 to over 100 milliseconds. After the time period to allow this sequence (called training), the remote modem raises Clear-to-Send (CTS) to the terminal, which initiates the return message transmission. Again, this in-coming message contains overhead sync and pad characters, and even a simple no-traffic acknowledgement will typically require about five characters. If there is an input message, the length of the message could range up to several hundred characters. This is determined by the application and overall system design. The last delay, d_3 , is the turnaround response of the CCU/CPU combination, typically on the order of one character time. Thereafter the CCU would poll the next terminal, or, if the terminal had sent an input message, the CCU would acknowledge it and then go to the next poll. For an outgoing message to a terminal, a similar but two steps more elaborate series of events occurs. The CCU addresses or "selects" the terminal, the terminal answers, the CCU sends the message, and the terminal acknowledges.

With the foregoing discussion in mind, the system input rate in the absence of transmission errors can be expressed by the following (where Poll and M are the times required to transmit the poll and input message — whether the latter is a no-traffic acknowledgement or an actual input message):

$$T_s = \frac{\text{Poll} + M \text{ in}}{2(d_1 + d_2) + d_0 + d_3 + d_t + \text{Poll} + M \text{ in}} \times \text{Modem Data Rate}$$

In other words, the input rate is equal to the sum of the time devoted to message transfer divided by the total time elapsed in an outbound poll and the resulting response. To optimize system throughput, then, the designer must seek to reduce the various delays to a minimum. In most systems, delays d_0 and d_3 are device related, not usually under designer control, and generally statistically small compared to the other factors. The delay d_2 is the actual transmission delay over which the designer has little influence because it is essentially geographically determined. We are left, then, with d_t , the modem training time and d_1 , the internal modem delay as major controllable factors related affecting system throughput. Both of these parameters are related to the type and speed of the modems used, and

are shorter for slower modems with manual or fixed equalizers, and longer for high speed modems with automatic and adaptive equalization. Thus, there are tradeoffs to be made between the delay parameters d_1 and d_t and basic data rate.

Historically, the vast majority of multipoint networks have been implemented with modems running at speeds of 2400 bps or below. These modems have internal delays of only a few milliseconds. Also, they do not require any

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sophisticated equalization, so their training times (actually signal acquisition and timing recovery) are short, on the order of 8 to 15 milliseconds. Since transmission bit error rates for 2400 bps modems are also very low under normally good line conditions, the overall throughput efficiency and reliability have been excellent for many applications. For other applications that have greater traffic rates or shorter response time, users have begun implementing multipoint networks with 4800 bps modems. Two modem types have been available at these higher data rates: those which are manually equalized and those that are automatically equalized. Manual equalizers are set up for the communication circuits characteristics at installation, and are readjusted whenever circuit characteristics change sufficiently to warrant it. Because of their static nature they have relatively low delays, on the order of 10 to 15 msec. Automatic equalizers, on the other hand, set-up or "train" to meet specific line parameters each time a new signal is received, and also continuously adapt to changing line parameters. The disadvantage of automatic equalizers is the greater internal delay, and especially the longer training delay, d_t , which is repeated everytime a poll response is initiated on the incoming leg of a multipoint circuit. Typical RTS/CTS or training delays for high performance modems operating in multipoint systems are shown in Fig. 3.

FAST POLL MODEMS

In evaluating the response times and throughput associated with multipoint systems, Codex Corp. set out to combine the best features of the fast response 2400 bps modem with the throughput speed of faster automatically equalized units. The result is the Multipoint Fast Poll Series, which is a part of the new Codex LSI Series of high speed modems. The basic technique used in this series is that data transmission on the incoming side is begun at a rate of 2400 bps, using a modulation technique that does not require extensive equalization. Thus, the RTS/CTS delay is kept to the minimum level of only 9 msec. Then, while the transmission proceeds at 2400 bps, the receiving or master modem does an automatic equalization on the incoming signal. After 64 bits of data at a rate of 2400 bps is received, the training is complete and both the sending modem and the receiving modem automatically "gearshift" up in synchronism to the faster 4800 bps rate. Thus, for longer incoming messages, the RTS/CTS delay penalty associated with automatic equalization is reduced, and faster throughput rates can be realized. Fig. 4 is a graphical representation of the throughput performance of the Fast-Poll modem series with comparison to a standard 2400 bps unit (201 Type) and a standard 4800 bps automatically equalized modem.

Another problem frequently associated with multipoint networks is the uneven distribution between incoming and outgoing channel loadings. For example, in many interactive multipoint systems, the input message consists of a name, a number, or similar short identifying message. The output then consists of a much longer message, even up to a full CRT screen. The Codex Multipoint Fast Poll series keeps up by means of outbound speeds at 7200 and 9600 bps. Since the outgoing channel operates by means of constant carrier, the slave modems need focus only upon system equalization. Moreover, these more powerful equalizers, though they may take longer to equalize or train than do 4800 bps units, do so only once, so they have virtually no adverse impact on systems throughput. Conversely, modems with the higher outbound speeds deliver the longer out-

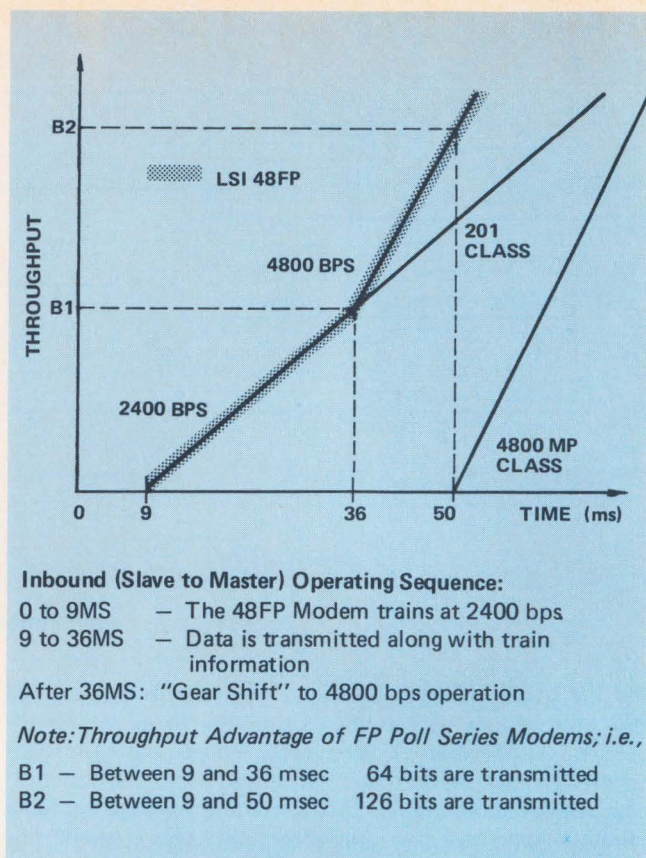


Fig. 4. Multipoint Fast Poll Performance

bound messages in much less elapsed time. The net result is that these modems contribute substantially to improved system throughput.

DETAILED ANALYSIS

The preceding discussion reflects how communications links can affect system throughput and response time. It was shown how some modem parameters affect these values and how system improvements can be achieved through advanced modem design. My discussion does not, however, provide any specific way to measure the system performance of any particular multipoint network. Why not? Because it is highly complex to determine a specific system response time and throughput. They are affected by a large number of system parameters, many of which have multiple values and can be described only in terms of a probability distribution.

The only effective way to really analyze an extensive multipoint network is through the use of a simulation model. This technique is described in great detail in James Martin's book, *System Analysis for Data Transmission*, Prentice-Hall, 1972. [By the way, I highly recommend this book. It gives: a thorough analysis of system parameters, common sense considerations on modelings limitations, and insights on how simplifying assumptions made when establishing simulation models can impact a network operation.] Another attempt at evaluating multipoint network characteristics is a collection of nomographs included in an article, "Tavograms" (Modern Data, Feb. 1976). There are limitations in its use, but as the author states: "The resulting accuracy is more than sufficient for a 'first cut' design and analysis, and the number of design alternatives is reduced to a manageable level so that extensive analyses can be performed."

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Dr. Ruben F. Mettler, president of TRW, Inc., will deliver the keynote address at the Wescon Luncheon, held Monday, Sept. 13, at the Los Angeles Hilton, convention headquarters.

In addition to the exhibits and 34 half-day technical sessions, there's the continuous Technical Film Theater, the all-industry cocktail party Tuesday evening at the Hilton and between 50 and 75 meetings of IEEE, EIA and other committees.

All sessions will be held in the Convention Center. Those relating to minis/micros are listed below.



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WESCON/76 PROFESSIONAL PROGRAM SCHEDULE

TUESDAY, SEPT. 14

10 am – 12:30 pm

SESSION 1: MICROCOMPUTER APPLICATIONS

Organizer/Chairman: Robert Van Naarden, Digital Equipment Corp., Marlborough, MA.

Microprocessor Simplifies Impedance Measurement. M.A. Gipe, H.B. Hall, R. Sullivan, GenRad, Concord, MA.

The Microcomputer and Photographic Printing System. Robert C. Davis, Bremson Photo Industries, Kansas City, MO.

Microcomputers In Voice Input Systems. Marvin B. Herscher, Threshold Technology, Delran, NJ.

2230 Module Test System – A Microcomputer Application. Thomas J. Coughlin, GenRad, Concord, MA.

SESSION 2: MINICOMPUTER POWER SUPPLIES

Organizer/Chairman: Cle Riggins, Hewlett-Packard Data Systems, Cupertino, CA.

User Performance Requirements for Minicomputer Power Supplies. Rudolf Severns, Magnavox, Torrance, CA.

The U.L. Approach to Safety for the Minicomputer Power Supply. Robert Harris, Underwriters Laboratories, Santa Clara, CA.

Interfacing Utility Supplied Power with Critical Loads. P.L. Wheeler, Southern California Edison Co., Rosemead, CA.

Power Supply Design for Today's Minicomputer Needs. Kenneth Check, Hewlett-Packard Data Systems Division, Cupertino, CA.

1:30 – 4 pm

SESSION 6: MICROPROCESSOR DESIGN AIDS – THE MICROPROCESSOR MANUFACTURER'S VIEWPOINT

Organizer/Chairman: David N. Kaye, Electronic Design Magazine, Los Angeles, CA.

Fairchild's Microprocessor Aid Philosophy. Anthony R. Beccia, Micro Systems, San Jose, CA.

Design Aids for the 6800. Don Kesner, Motorola Semiconductor, Phoenix, AZ.

Low-Cost National Microprocessor Design Aids. Philip M. Roybal, National Semiconductor Corp., Santa Clara, CA.

Design Aids for Intel Microprocessors. Bill Broderick, Intel Corp., Santa Clara, CA.

SESSION 9: NEAR TERM SATELLITE COMMUNICATIONS SYSTEMS

Organizer/Chairman: S.H. Durrani, NASA Goddard Space Flight Center, Greenbelt, MD.

The Aerosat Program: System and Status. Frank Carr, FAA, Washington, DC.

The Indonesian Domestic Satellite System. Bruce R. Elbert, Hughes Aircraft Co., Los Angeles, CA.

Anik 4: The New Canadian Domestic Satellite. R. Hoedemaker, RCA-AED, Princeton, NJ.

The Comsat General-AT&T Domestic Satellite System. M.C. Kim, Comsat General Corp., Washington, DC.

Fleet Satellite Communications Spacecraft. Jack Friendenthal and E. Heist, TRW Systems, Redondo Beach, CA.

TV Distribution Via Satellites. John Ball, Public Broadcasting Service, Washington, DC.

10 am — 12:30 pm

SESSION 11: MICROPROCESSOR/MICROCOMPUTER STANDARDIZATION SCHEMES IN INDUSTRY AND GOVERNMENT

Organizer/Chairman: C.E. Holland Jr., Naval Electronics Laboratory, San Diego, CA.

An Approach to Microprocessor/Microcomputer Standardization in Navy Systems. Ralph Martinez and Reeve Peterson, Naval Electronics Laboratory Center, San Diego, CA.

Military Distributed Processor for Global Positioning System. Leo Chamberlin, Texas Instruments, Dallas, TX.

Microcomputer for Multiple Applications. C.D. May Jr., and R.E. Mellott, Control Data Aerospace Division, Minneapolis, MN.

Compatibility Among Families of Microcomputers. Hank Molloy, Intel Corp., Santa Clara, CA.

1:30 — 4 pm

SESSION 16: UNIVERSAL MICROPROCESSOR DESIGN AIDS

Organizer/Chairman: Zoltan Tarczy-Hornoch, Systron-Donner Corp., Concord, CA.

Design of a Universal Microcomputer Development System. Bruce Gladstone, Microkit Inc., Santa Monica, CA.

A Universal Instrument for Software/Hardware Troubleshooting. Zoltan Tarczy-Hornoch, Systron-Donner Corp., Concord, CA.

Feasibility of a Universal Bus for 8, 12, 16 Bit Microprocessors in a Development System. Bryan G. Moonier, Micro Specialists, Hollywood, CA.

Universal In-Circuit Emulation. Roger Doering, Digital Electronics Co., Berkeley, CA.

THURSDAY, SEPT. 16

10 am — 12:30 pm

SESSION 21: MICROCOMPUTERS FOR FUN AND PROFIT

Organizer/Chairman: Frank J. Burge, Regis McKenna Advertising, Palo Alto, CA.

The Hobby Computer Market. Bob Wickham, Vantage Research, Los Altos, CA.

What Are Hobbyists Doing with Microcomputers? Eddie Currie, MITS, Albuquerque, NM.

The Microcomputer for the Home. Manfred Peschke, Byte Magazine, Peterborough, NH.

The Future of the Neighborhood Computer Store. Paul Terrell, The Byte Shop, Mountain View, CA.

SESSION 23: FUTURE LSI TECHNOLOGIES

Organizer/Chairman: B. Dunbridge, TRW Systems Group, Redondo Beach, CA.

CCD Large Scale Memory. Robert W. Bower, Mnemonics Inc., Cupertino, CA.

VLSI Bipolar Technology. James L. Buie, TRW Defense & Space Systems Group, Redondo Beach, CA.

A Silicon Monolithic Technology for 1-2 GHz Analog Signal Processing. David R. Breuer, TRW Defense & Space Systems Group, Redondo Beach, CA.

I²L/LSI for Complex Logic Arrays. Donald E. Romeo and Klaus Schuegraf, Northrop Research & Technology Center, Hawthorne, CA.

1:30 — 4 pm

SESSION 26: HIGH PERFORMANCE BUILDING BLOCKS FOR MICROPROGRAMMED SYSTEMS

Organizer/Chairman: Rudolph Panholzer, Naval Post-Graduate School, Monterey, CA.

Microprogrammable Bit Slices — An Overview. Peter Alfke, Fairchild Microsystems, San Jose, CA.

Microprogramming for the Hardware Engineer. John R. Mick, Advanced Micro Devices, Sunnyvale, CA.

Application of Bipolar Bit-Slice Microprocessors. Rob Walker, Intel Corp., Santa Clara, CA.

The Bipolar Microprocessor Revolution of 1976. John Birkner, Monolithic Memories, Sunnyvale, CA.

SESSION 28: NEXT GENERATION — THE LSI COMPUTER SYSTEM

Organizer/Chairman: William J. Thomas, Four-Phase Systems, Cupertino, CA.

Semiconductor LSI and Computers of the Future. Bob Wickham, Vantage Research Services, Los Altos, CA.

Emerging Trends to Reduce the High Cost of Microcomputer Utilization. Manny Lemas, Microcomputer Associates, Santa Clara, CA.

to be announced
John Stidd, Four-Phase Systems, Cupertino, CA.

Microprocessor Architecture Vs. High-Level Language Execution. Charlie Bass, Zilog, Los Altos, CA.

FRIDAY, SEPT. 17

10 am — 12:30 pm

SESSION 31: SINGLE-BOARD COMPUTERS: THE EMERGING MICRO VS. MINI BATTLE

Organizer/Chairman: Dave Bursky, Electronic Design Magazine, Rochelle Park, NJ.

Hardware Aspects: Micros Vs. Minis. Bob Pecotich, National Semiconductor, Santa Clara, CA.

Packing Capability Into Microcomputers and Minis. George Adams, Intel Corp., Santa Clara, CA.

Evaluating Mini Vs. Microcomputer Software Development Tools. Duane Dickhut, Digital Equipment Corp., Maynard, MA.

The Minicomputer Vs. Microcomputer On-A-Board Decision. Ed Zanders, Data General Corp., Southboro, MA.

Should You Use a Microcomputer to Replace Hard Wired Logic? Matt Biewer, Pro-log Corp., Monterey, CA.

minicomputers and microcomputers

MINICOMPUTERS — PART 3

EDITOR'S NOTE:

Following an introduction in the April issue, Part 2 of this Profile in May surveyed the current status of microcomputers. Here in Part 3, an attempt is made to summarize the various offerings from the minicomputer manufacturers.

For nearly fifteen years, trade magazines, market research organizations, and other observers of the computer scene made surveys of minicomputers that placed the machines in an easily identifiable category, a specific and well-defined product to be compared in terms of word length, memory size, memory speed, I/O ports, number of registers, and the like.

In recent years, such surveys have found that they need to devote more and more space to defining a minicomputer and to differentiating it from other kindred systems, such as midcomputers, small business processors, and remote batch processors. The microcomputer has come on strong over the past two years, so now the semantic uncertainty has become even more complex... and imperative to resolve.

Some of our profound brethren in research go to great pains to classify a computer as a mini if it has a basic price of under \$20,000 (and a midcomputer as one costing between \$20,000 to \$50,000.) Then the wise men proceed to establish other broad definitions such as a mini is one with a word length between 8 and 32 bits, memory range 4K to 56K (but up to 1 million bytes is allowed), and 1 to 32 registers. But when it comes to executing the survey, the survey chiefs undergo a change of heart and include systems which cost up to \$250,000.

Clearly, the previous simple minicomputer world has now changed. The minicomputer originally was so titled simply because its physical size was small. The name had nothing to do with performance limitations. No less an authority than *Scientific American* attests to that. Be that as it may, the first minicomputers differed vastly from the larger computers of their time. Besides their smallness, the machines had word lengths that were considerably shorter than those used in conventional computers and they also had a much greater I/O capability in the form of interrupt levels and direct memory access. During the decade that followed the mini's introduction, both the machine's capabilities and price have climbed to approach that of the larger machines. Simultaneously, they have moved in the opposite direction — toward the levels now occupied by the micro-

computer. Today, the small machines can solve virtually any kind of computation or control application. And because the big mainframes were also being extended in multiple directions, they and the minicomputers borrowed architectural innovations from each other.

After more than a decade of frenetic innovation that includes the advent of fast, large, and cheap memories and LSI registers and processing units, the minicomputer's power now extends from the "traditional" small mainframe having 4K of memory and costing under \$3000 to the 16- and 32-bit machines having one million bits of core and costing \$250,000. Indeed, the upper performance range goes beyond the capability of some "conventional" computers. The point is that a practically, continuous spectrum of computing equipment is available beginning with the \$25 microprocessor and extending to the multi-million-dollar ASC.

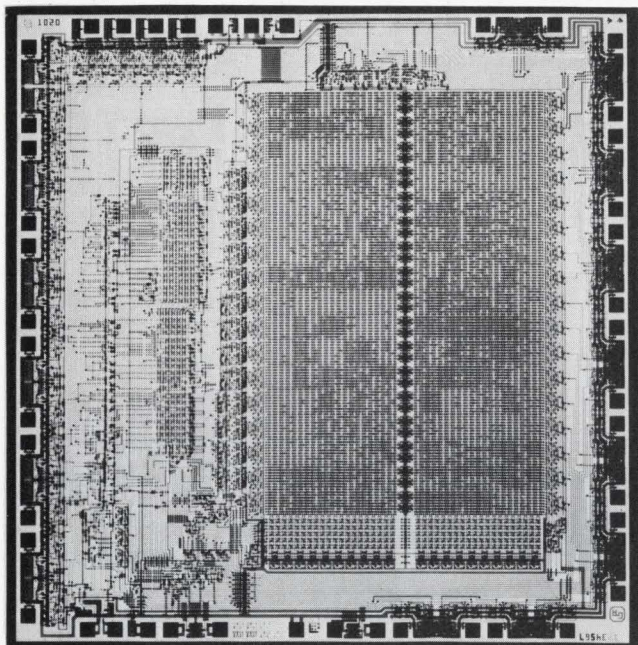
So-called minicomputers are now available that have many times more power than does a typical IBM System/360 introduced only a few years ago. They are available in dual processor configurations and as time sharing sys-



One million byte minicomputer by Computer Automation, pictured with high-speed disks, floppy disks, printer, card reader and CRT, comes with 224 instructions.

tems. Minicomputer networks can be adapted to dispersed data processing problems. In addition, minicomputers can have virtual memory. Many minicomputers are based on microprogramming, (called firmware a decade ago) and this effects the apparent hardware configuration; many minicomputers have push down stack architecture (a concept on which the author was issued a patent almost a decade ago). Minicomputers can be hooked up to any kind of

peripheral known. In fact, most minicomputers are linked to a conglomeration of disks, tapes, and terminals whose combined cost can far outweigh that of the mainframe. The situation will become even more unbalanced as semiconductor electronics continue to decrease in cost. That is why peripheral equipment is the area in need of most innovation and new concepts.



A control read only memory chip in the General Automation 16/110 and 16/220 microcomputers is used to optimize the system performance in a non-standard application.

Since minicomputers now reach into the market to compete with conventional computers, they, too, come with massive amounts of software, complete field service, and after-sales applications support. All of this is a far cry from the original minicomputers that arrive in a box containing a manual and that were programmed in object code or crude assembly languages. Most large minicomputer systems are supplied on a "turn-key" basis by the manufacturer: The user acquires a mainframe complete with peripherals and software and communications capabilities that have been arranged to do his job, just as if he were buying a standard IBM 370 system. It is traditional in minicomputer surveys to outline and describe typical minicomputers applications, but there is no longer any such thing. Virtually all computing applications - business, control, instrumentation, data collection, and so on - can be done by a "minicomputer," or a system of minicomputers and peripheral equipment.

A similar story holds for minicomputer software, whose scope and capabilities now approach the programming available with large CPU's. Operating systems have been developed for use on a single minicomputer and on networks of minicomputers. Compiler languages, such as Cobol, Fortran, and Basic, are available on most of the popular minis. Communications handling packages, among the first to be needed, are now available in profusion. Indeed, the variety of application packages and utilities almost rival the packages available for IBM equipment.

In computing systems of the future, the mini will be even more important. As we have said many times, the trend is away from the concept of one massive central computer to handle everything. This outdated approach that requires multi-partitions, multi-programs, multi-processes, operating systems, supervisors, file management, and other

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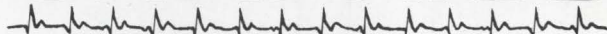
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unessential operations is wasteful of storage space and time. The concept, a woolly mammoth, is one whose time has past. The future of the computer business instead is in distributed processing, the decentralization of computing power via smaller processors that are strategically placed from an applications point of view.

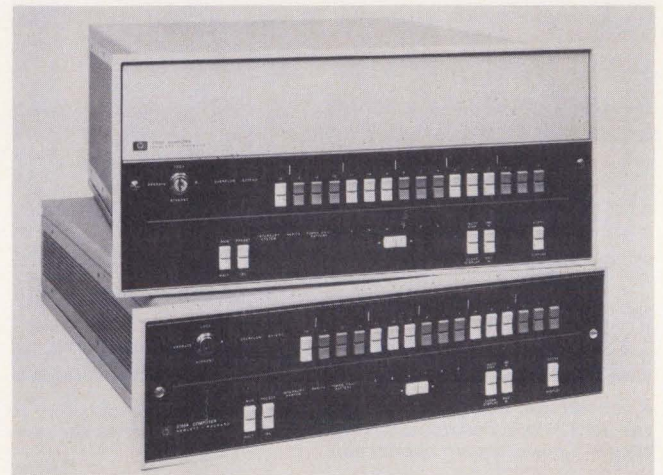
The CPU's, though more single-minded than the Goliaths, are vastly more efficient in the aggregate. Microcomputers in each peripheral will relieve the mainframe of editing, formatting, buffering, and housekeeping tasks. Unburdened, the central computer is reduced to coordinating the operations in the mini-based network. With microcomputers in each peripheral, with a "minicomputer" to handle communications problems, and with yet another minicomputer coordinating the sequence of events, the computation system of the future will be conspicuous by the absence of a conventional central processor. The reason is obvious: Four smaller machines can be much more flexible and have much more processing power than does a single machine that may be four times the size of each small computer. The minicomputer, therefore, is in an ideal position to be the instrument through which these systems are implemented.

Let us now proceed to our survey of what can be commonly accepted as minicomputer mainframes. We shall define a minicomputer somewhat loosely as having a word-length of 16 bits or less (though some minicomputers have 32 bit word length; most, however, are 16 bits wide in memory). Under our definition, a minicomputer has a 4K memory at least and a usable range between 16 to 64K (but they can have 1/2 million words.) Our minicomputer will

also be very I/O oriented and have extensive interrupt capability and direct memory cycle access.

In this Profile we are concerned only with minicomputer mainframes, or minicomputers, and some definitions we have developed pertain to the small computer only:

- **Microprocessor:** A computer processing unit contained in a single plug-in semiconductor chip.
- **Microcomputer:** A microprocessor affixed with memory and input-output logic or circuits so that it can perform a useful function.
- **Microcomputer system:** A microcomputer affixed with peripherals to be applied to realworld problems. (Note, that both microprocessors and microcomputers can be incorporated into other machines, such as peripheral equipment, and therefore they need not be part of a microcomputer system.)



Users can microprogram the Hewlett-Packard 21-MX line of minicomputers because of the machine's design with semiconductor main memory.

- **Minicomputer** (also called a minicomputer mainframe): A computer, as defined above, complete with processing unit, memory, input-output circuitry power supplies, and some programming facility.
- **Minicomputer system:** A minicomputer affixed with peripherals and, having sufficient software so that it can be applied to problem solving.
- **Conventional computer:** A large computing machine, complete with processor, memory, and input-output equipment, and that typically is *not* sold without first having been incorporated into a complete system.
- **Computer system:** A computer, complete with peripheral equipment and extensive software capabilities, operating system, compilers and other supports, all ready to be applied to a "large" real-world problem.

According to the 1976 *Minicomputer-Microprocessor Market Survey*, published by Modern Data Services Inc. (Mini-Micro Systems' parent company), U.S. manufactured minicomputers in place worldwide at the end of 1975 totaled 190,000. Some 133,000 are located in North America, an increase of approximately one third over the prior year. What follow are profiles of the minicomputer vendors. And though a vendor's products start off at the microcomputer level and continue right up through to computers having the capabilities of conventional computers, our purpose is to survey the minicomputer mainframes only. These are sometimes called OEM minicomputers, because they are bought primarily by original equipment manufacturers who integrate them, along with peripherals and soft-

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ware, into complete computer systems for sale to others. The following sketches indicate the peripheral equipment available with a vendor's mainframes, and also the extent of its software. However, any mini-mainframe vendor can generally supply any peripheral that a customer may want to affix to the system.

MINICOMPUTER MANUFACTURERS

CINCINNATI MILACRON

Cincinnati's minicomputers comprise two 8 bit processors, the CIP-2200B, and the recently announced 4400. The 2200 is provided with 1 microsecond core in quantities of 8K to 64K, and the 4400 has 800 nanosecond MOS from 32K to 96K. The systems are not microprogrammable by the user and have a moderate selection of peripheral equipments. Assembler, RPG and a batch operating system are provided. Prices begin around \$5000.

COMPUTER AUTOMATION INC.

Computer Automation markets four basic 16-bit minicomputers which can be purchased in any configuration from a single board processor through a complete system. The systems can all be up to 32 bits wide in the processor. Both core and MOS memories are available with speeds from 850 nanoseconds to 1.6 microseconds. The LSI-3/05 "naked milli" begins at \$465 with 256 words of memory which can be expanded to 256K, and has a minimal selection of peripheral equipments, and has assembly level software.

Next is the LSI-2/10, at a base price of \$1750, with core capacity from 4K to 256K words, and a reasonable selection of peripherals. Assembler, Fortran, Basic, and operating systems are provided. The "naked mini," LSI/220, is a somewhat faster version.

At the top of the line is the megabyte LSI/260, with core capacity from 8K to 512K words, and the same selection of peripherals and software as the naked-mini; base price is under \$7000.

CONTROL DATA CORP.

CDC offers the System 17, an 18 bit machine with MOS memory in quantities of 4K to 65K. It is a non-microprogrammable machine with a moderate selection of peripheral equipments. Software includes assembler, Fortran, RPG, and operating systems. Base price with 4K of memory is in the \$14,000 range.

DATA GENERAL CORP.

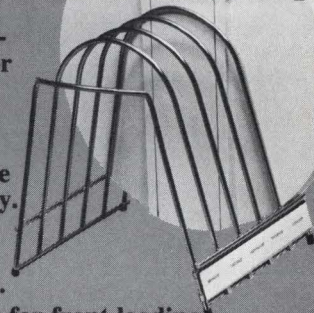
Data General's minicomputer line begins at the microcomputer level and extends through powerful general purpose machines and commercially oriented processors and systems. Starting prices range from \$950 for the single board unit version of the microNova (with 4K words of memory) to \$30,000 for the Eclipse C-300 commercial machine.

Data General's oldest and broadest line comprises the Novas, a series of 16-bit machines which range from the older Nova 2, to its replacement the Nova 3, up through the Nova 800 and 1200 models. The Nova line is built around core memory of 0.8 to 1.2 microsecond cycle time, and capacities from 4K to 32K words. Except for the newer Nova 3, on which one has a choice of core or MOS memory, they are not microprogrammable. Prices begin below \$2600 for the Nova 3 and in the \$6-12K range for the mid-range Nova 800 and 1200. The Novas are available with any desired peripheral. Nova software includes assembly language, Fortran, Algol, Basic, and several operating systems. All Nova-line computers are mutually program compatible.

Data General's recent and more powerful line of machines is the Eclipse, which is available in either core or

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MOS memory with minimum capacity of 16K words, extending to 131K. Cycle times are 800 nanoseconds for core or 700 nanoseconds for MOS. A 200 nanosecond bipolar cache memory is used to enhance effective memory speed. All necessary peripherals are available, as are the software capabilities described above for the Nova; RPG is available in addition on the Eclipse C-300.

DATAPOINT CORP.

Datapoint's approach to OEM mainframes is consistent with their general posture as one of the leaders in the distributed (or dispersed) data processing business. The basic system is the Datapoint 1100, an 8-bit machine with instruction length up to 64 bits. The 1100 uses 1.6 microsecond MOS memory in quantities to 4K to 16K words. Peripherals are limited to those needed for business applications or provided with the machines, and a strong data communications interface. Assembler, real-time operating system, and extensive applications packages including Basic, RPG, and Datapoint proprietary packages are all included with the system.

The 1100 comes complete with a CRT and dual cassettes for \$7000, or the CRT and floppy disks for \$13,000.

Datapoint also offers the 2200 and the 5500, which are similar in concept to the 1100 but have increased business processing capability. The top of the line 5500 comes only as a bundled business system, in the mid \$20,000 range.

DATUM INC.

Datum very recently introduced a line of small computers, the Nucleus series, based on its Enhancer I processor, which has the same characteristics as the General Automation SPC 16 system. This is a 16 bit processor with 1 microsecond

core memory ranging from 4K to 131K and available with all the usual peripherals, an assembler, and Fortran, Basic, and Cobol, and operating systems. Price of Enhancer I begins at under \$4000. The Nucleus series comprises end user small business processors.

DIGITAL COMPUTER CONTROLS, INC.

DCC offers a range of 16 bit machines: the series D-116, -216, -316, -416, -616, and the newer mod 5. Both core and MOS machines are available with cycle times ranging from 600 nanoseconds to 1.6 microseconds: capacity starts around 1K and go as high as 1 million words. Beginning prices are in the \$2K range, \$3K with 8K words of core. The majority of common peripheral equipments are available, and software includes assembler, Fortran, Basic, Iris, and a range of operating systems.

DIGITAL EQUIPMENT CORP.

Digital is far and away the leader in the miniframe business as well as the minicomputer systems business. Digital (formerly known as DEC) offers mainframes at prices ranging from \$600 to more than \$200,000, if one includes the LSI 11 microcomputer.

The most durable and most copied minicomputers in history come from the PDP-8 class, of which the current versions are the PDP-8/f, PDP-8/m, PDP-8 A/100 and PDP-8 A/400. PDP-8's have 12-bit word length, and use core memory with cycle time of 1.2 microseconds, except for the A/100 which has a semiconductor memory. Memory capacity is from 1K to 32K words. They are not microprogrammable. Virtually any peripheral ever invented has been interfaced to the PDP-8 family either by Digital itself or by one of the many independent systems houses which make a living supplying compatible products for the PDP-8. PDP-8 software includes assembly language, Fortran, Algol, Basic, Dicol, Focal, and operating systems are available. Prices start at \$3000.

The PDP-11 comprises 8 models of 16 bit machines, primarily with one microsecond core memory, although semiconductor memory is available on the 11/45. Memory sizes range from 4K to 32K words on the smaller models, 8K to 131K on the intermediate levels, and 65K to 1 million words on the top of the line 11/70. All of the usual peripherals are available. Software includes assemblers, Basic, and Cobol, with batch, real-time and time sharing operating systems available. Base prices begin at \$2500 for the smaller machines, \$17,000 at the intermediate level and \$55,000 in the 11/70's.

Digital also markets two processors based on its older PDP-15 series; these are 18 bit machines, 1 microsecond core memory in an applications range now largely usurped by the upper level 11/70.

Digital's complete line includes minicomputer systems made from these miniframe, complete with peripherals, software, etc. Digital also markets the DECsystem 10, a full scale business computer system.

GENERAL AUTOMATION INC.

GA markets a range of miniframe extending from a single PC board to fully packaged systems. Their older SPC-16 is a 16-bit machine with 4K to 128K words of one microsecond vintage core memory, a good selection of peripherals, and software including assembler, Fortran, Basic, Cobol, and operating systems for \$4000.

The GA-8/55 is an 8-bit machine with 500 nanosecond NMOS memory in quantities from 1K to 57K, and is basically an OEM version on one or more printed circuit boards. Minimal peripherals and software are available with the sys-

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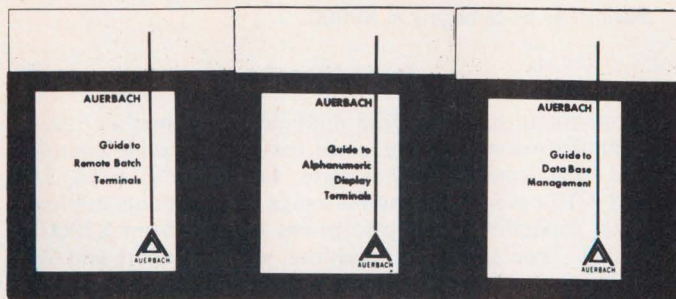
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tem. The GA-16 series has 5 versions; the 16/110, 16/220, 16/330, 16/340 and 16/440 are all 16 bit machines with 500 nanosecond NMOS or 800 nanosecond core memory, from 1K for the smaller machines and 16K for the upper three models. Maximum core capacity on the 16/440 is one million words; the others top out at 64K. An adequate complement of peripherals is available, and software includes assembler, Fortran, Cobalt, Basic, and operating systems. The entire GA-16 family is software compatible with itself and with the SPC-16 system.

HARRIS CORP.

Harris has 3 offerings of OEM miniframe, in addition to its wide variety of end user systems based on these minicomputers; Slash 5, Slash 6, and Slash 7 are 24 bit machines. The Slash 5 offers one microsecond core memory in capacities from 8K to 64K words, and has a reasonable range of peripherals available; it begins at around \$16,000. The Slash 7 has the option of 1/2 microsecond core or 200 nanosecond MOS memory, from 32K to 256K words, and has an adequate range of peripherals. The Slash 7 begins at \$45,000. The Slash 5 and the Slash 7 minicomputers were acquired in the Harris acquisition of Datacraft Corp.

Harris' newest offering is the Slash 6, which is entirely MOS memory, and begins at \$14,500 with 48K bytes.

Assembler, Fortran, Cobol, Basic, RPG, Snobol and a full range of operating systems are available with the Harris minicomputers.

HEWLETT-PACKARD CO.

HP's miniframe family is the 2100 series, also known as the 21MX, comprised of models 2100A, 2105A, 2108A and 2112A. These are 16 bit machines with 650 nanosecond MOS memory in quantities beginning at 4K and extending to 32K words on the lower level machines and 128K on the higher end. A reasonable selection of peripherals is available. Software includes assembler, Algol, Basic, and good selection of operating systems. Prices begin around \$5500 for the low end of the line, and around \$7500 for the upper end of the line.

HP's newest and most powerful line is the 3000 series, 16-bit computers using 900 nanosecond core memory with top capacity of 65K. The 3000 is basically sold as the central element of a large data base or terminal oriented system, but can also be bought on an OEM basis. A full range of peripherals and software is provided. Prices begin around \$100,000.

HONEYWELL INFORMATION SYSTEMS

Honeywell entered the minicomputer business by purchasing one of the original minicomputer companies, Computer Control Co., and now offers three lines of 16 bit machines: the H316, the System 700 and the Level 6. The 316 and 700 are program compatible.

The 316 has 1.6 microsecond core in sizes from 4K to 32K and is available with a good selection of peripherals. Software includes assembler, Fortran and Basic, and DOS and RTOS operating systems. Prices begin at about \$8000.

The System 700 has 3/4 microsecond core from 8K to 65K words, and, like the 316, is not microprogrammable. A moderately good selection of peripherals is available. Software includes assembler, Basic, and operating systems. Prices begin around \$10,000.

The new Level 6 comes in three versions, the 6-34 and 6-36 for the OEM and the 6-06 for the end user. All are microprogrammable and feature NMOS memory in quantities from 8K to 64K. A good selection of peripherals is available and prices begin under \$4000 for the model 6-34. Assembler, Fortran and a real-time operating system are available.

IBM CORP.

IBM's 5100 is billed as a portable computer, and is intended as a stand alone small computer rather than a main frame to be incorporated into larger systems. 16K to 64K bytes of memory are available, and the machine is microprogrammable by IBM but not by the user. Input-output capabilities are limited, and CRT display, printer and tape cartridge are the only peripherals available. Programming is in APL or Basic. The price begins at \$9000.

INTERDATA

Interdata pursues the OEM miniframe market heavily, although not exclusively, since they also provide complete and large scale turnkey systems. Models 5/16, 6/16, 7/16 and 8/16 cover the complete range of traditional minicomputer capability, their base prices ranging from \$1000 to \$5000. They are 16 bit machines, with both core and MOS memory available in most models at 1 microsecond and 600 nanoseconds, respectively. Core capacity begins at 4K words and ends at 32K for the smaller models. The newer machines can go up to 64K at the smaller end, and 1 megabyte can be accommodated by the larger systems.

The 7/32 and the 8/32 megaminis are large scale 32-bit machines with direct accessing of 1 megabyte of 300 nanosecond memory. Prices begin in the \$3000 range for the smaller machines, in the \$15,000 range for the intermediate level 7/32, and at \$52,000 for the 8/32 (with 131K bytes of core memory). Assembly language, Basic, Fortran, and complete operating systems are available on the Interdata minis.

KERONIX, INC.

Keronix offers three 16-bit machines, the IDS 16-12, 16-10, and 16-8. These machines are available with one microsecond core memory in sizes from 4K to 512K words. They are not microprogrammable, and an adequate range of peripheral equipments is available. Software consists of assembler, Basic, Fortran, and a realtime operating system. Prices begin at \$2900 for the -12 and -10, and \$3400 for the -8.

LOCKHEED ELECTRONICS CO.

Lockheed's miniframes are the LEC-16 and SUE, both 16-bit machines with 1 microsecond core memory in quantities from 4K to 64K; a reasonable selection of peripherals is provided, as are assembler, Fortran, and RPG software. Prices begin in the under \$4000 range.

MICRODATA CORP.

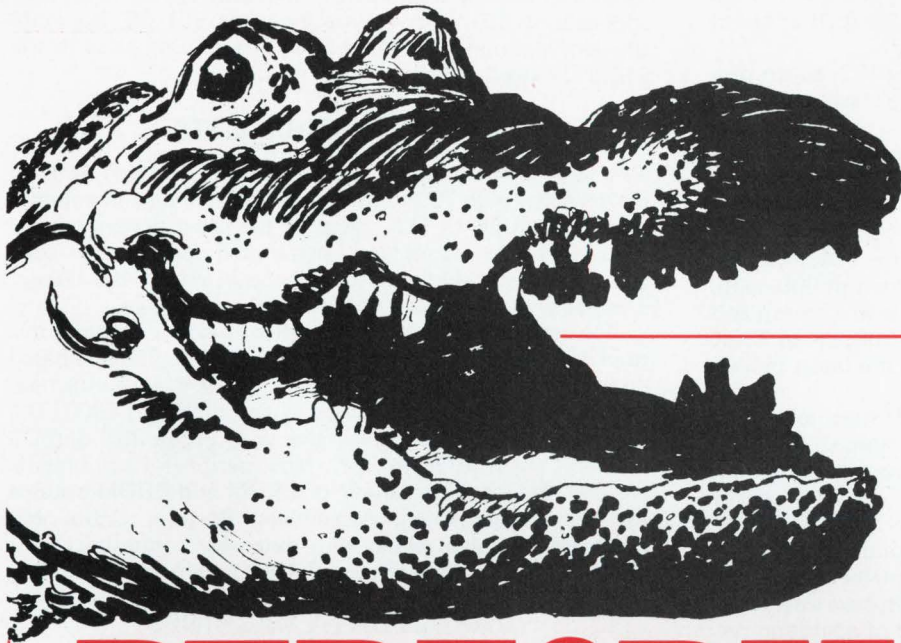
Microdata offers a full range of equipment from single board processors to packaged user systems. At the bottom of the line are three 8-bit processors which can operate on instructions and data up to 32 bits in length; these are the Micro-one, 1600/21, and 1600/30. They feature one microsecond core memory in quantities from 4K to 32K, a moderate selection of peripherals, assemblers, Fortran and Basic software, and entry prices in the \$5000 range for the older 1600 series and in the \$3000 range for the new Micro-one.

In 16 bit machines, Microdata has the 32/S, and the 3200; these have 350 nanosecond MOS memory, with capacity of 4K to 128K. A moderate variety of peripherals is available, and software is limited. Prices are in the \$10,000 range.

Microdata also markets Reality, a terminal-oriented system for business applications.

MODULAR COMPUTER SYSTEMS, INC.

ModComp offers four 16 bit miniframes, the ModComp I, II, IV, and the newest, ModComp II-2. ModComp's I, II, and IV use 800 nanosecond core memory in capacities from 8K to 32K words for the ModComp I, 16K to 64K for the



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ModComp II, and 16K to 256K for the ModComp IV. All systems are microprogrammable, and offer a reasonable assortment of peripheral equipments. Assembler is available on all machines, as is a real-time operating system. Fortran and Basic are available on the ModComps II and IV. Prices for ModComp I begin at \$6000, for ModComp II at about \$11,000, and at \$19,000 for ModComp IV.

ModComp's newest announcement is the II-2, which provides up to 48K of MOS memory and has a starting price of \$4000.

All ModComp machines are upward program compatible.

PRIME COMPUTER

Prime markets four 16 bit models: The Prime 100, 200, 300 and 400. All use MOS memory at cycle times of 600 nanoseconds to one microsecond (for the smaller machines), and in quantities of 4K to 65K for the 100 and 200, 8K to 262K for the 300, and up to 8 megabytes for the latest model, the 400.

Models 100 and 200 are primarily OEM machines; they are not microprogrammable, come with a reasonable assortment of peripheral equipment, and software includes assembler, Fortran and Basic. The Prime 100 begins at about \$4500 and the 200 at \$5500.

Prime models 300 and 400 are most commonly used in end user systems. They are microprogrammable, have a reasonable assortment of peripheral equipments, have assembler, Fortran, Cobol and Basic, and a full range of operating systems. Prime 300 begins at slightly over \$11,000. The 400, intended as Prime's entry into the distributed processing systems business, is geared to accommodate 64 time sharing users, has assembler, Basic, Cobol, and Fortran, has a complete range of operating systems, and begins at \$71,000.

RAYTHEON DATA SYSTEMS CO.

Raytheon markets two 16 bit processors with core memory, the RDS 500 with 8K to 64K of 800 nanosecond core, and the 704 with 4K to 32K of 1 microsecond core. Neither is microprogrammable, and both have a good complement of peripherals. Fortran compilers and a real-time operating system are available. Base price of both systems is in the \$7000 range.

ROLM CORP.

Rolm offers a line of small, lightweight rugged computers for militarized applications, based generally upon the Data General Nova architecture. They offer four 16-bit models: 1603, 1602, 1650 and 1664. All offer a choice of one microsecond core or CMOS memory, in quantities from 8K to 256K words, except for the 1603 which has a top limit of 32K. The machines are non-microprogrammable, and have a complete assortment of peripheral equipments. Software includes Fortran, Algol, Basic and a choice of operating systems.

The bottom of the line is the 1603, a replacement for the older 1601, with a beginning price of under \$10,000 with 8K core. The 1602 is \$18,750 with 8K of core, and its newer version, the 1650, comes at \$18,750 with its minimum 16K of core.

The top of the line is the just announced 1664, which is up to 64-bits wide in the processor, is at the Eclipse level of capability, and begins at \$30,000 with 8K of core. RTOS and RDOS are available on the 1664.

SYSTEMS ENGINEERING LABS

SEL markets three full-scale 32-bit machines, SEL 32, SEL 85, and SEL 86. All use core memory at 600 to 850 nanoseconds per word, with a minimum capacity of 8K words, and a top of 256K. A good selection of peripherals is pro-

vided on all machines. Software includes assembler, Fortran, and RPG, with a full selection of operating systems available. Prices begin at \$80,000 for the 85 and around \$100,000 for the 86; both of these machines are commonly sold in terminal and data-entry oriented, complete systems applications. SEL's newest machine, the SEL 32, is a more conventional miniframe, with a beginning price in the \$18,000 range.

TEXAS INSTRUMENTS

TI's older minicomputers are the models 960 and 980, 16 bit machines with 750 nanosecond MOS memory in volumes ranging from 8K to 65K. Most of the usual peripherals are available, as are assemblers, Fortran and operating systems; Basic is available on the 980. Prices begin in the \$4000 range. The 960 and the 980 are not microprogrammable.

TI's newest line is the 990, which is comprised of 2 distinct models, the 990-4 and the 990-10. The 990-4 is based upon TI's 9900 microprocessor and is therefore fundamentally a microcomputer: its price begins at around \$800. The 990-10 is a 16 bit miniframe with 8K to 20K of MOS memory, expandable to 32K. Most peripheral equipments are available, as are a variety of PROM and EROM options for microprogramming. Assemblers, Fortran, Cobol and Basic are available, along with extensive communications control software. Base price with 8K of memory is \$1975.

VARIAN DATA MACHINES

Varian markets four models in its V70 series, the V72, V73, V75 and V76. They are basically 16 bit machines, but the V75 can be configured also in 8 or 32 bits. Storage is MOS at 1/3 microsecond or core in the 1/2 microsecond range, with capacities starting at 8K in the smaller models and 65K in the top of the line V75, and going up to 262K. The systems are microprogrammable and most of the commonly used peripherals are available. Software includes assembler, Cobol, Basic, RPG, and the usual varieties of operating systems. Base price begins at \$4500 for the newest model, the V76, which also provides a cache memory. The top of the line V75 begins at \$35K with 64K of memory.

REFERENCE LITERATURE

For further information on the systems, use the reader inquiry numbers listed below.

COMPANY	READER INQUIRY NO.
Cincinnati Milacron, Lebanon, OH	55
Computer Automation Inc., Irvine, CA	56
Control Data Corp., Minneapolis, MN	57
Data General Corp., Southboro, MA	58
Datapoint Corp., San Antonio, TX	59
Datum Inc., Anaheim, CA	60
Digital Computer Controls, Inc., Fairfield, NJ.	61
Digital Equipment Corp., Maynard, MA	62
General Automation Inc., Anaheim, CA	63
Harris Corp., Ft. Lauderdale, FL	64
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Rolm Corp., Cupertino, CA	75
Systems Engineering Labs, Ft. Lauderdale, FL	76
Texas Instruments Inc., Houston, TX	77
Varian Data Machines, Irvine, CA.	78

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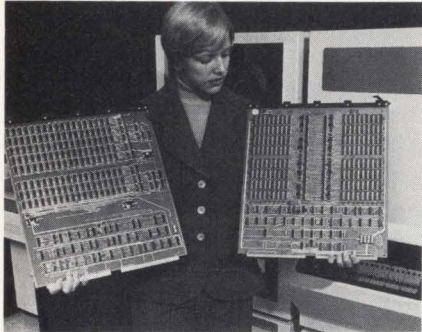
Complete Computer Systems

CIRCLE NO. 26 ON INQUIRY CARD

BARBARA A. REYNOLDS / Associate Editor

MEMORY MOVEMENTS

One of the "newest" products at this year's NCC was the 16K MOS memory chip from Intel Corp. But the announcement came not from Intel, but from Prime Computer, Inc., which is the first to use the 16K chip. This chip is used in a 256K-byte memory board that is



FOUR YEARS IN MEMORY TECHNOLOGY. On the left is Prime's new 256K-byte board using 16K chips. On the right is Prime's first memory board with a total of 8K bytes. In other words, one row on the new board has the same capacity as one old board. Both boards measure 16x18 inches.

used with either Prime's 300 or 400 central processor. The board with automatic error correcting code is \$35,000. Intel was reluctant to sound the trumpets too loudly until the chips were

being manufactured in large quantities. And Prime originally said initial deliveries of the board would be determined on a system-by-system basis. However, things are going well now and production shipments of Intel's chip and Prime's board should begin in September. How Intel's 16K-chip announcement fits into the changing world of semiconductor memory technology is shown in Fig. 1; what this means in terms of cost per bit is shown in Fig. 2.

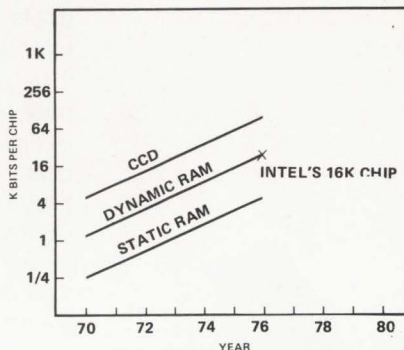


Fig. 1. Semiconductor Memory Advances¹

¹Chart taken from Electro '76 paper, "Semiconductor Memories, The Impact and Momentum of Current Technology," by R.J. Whittier of Intel Corp.

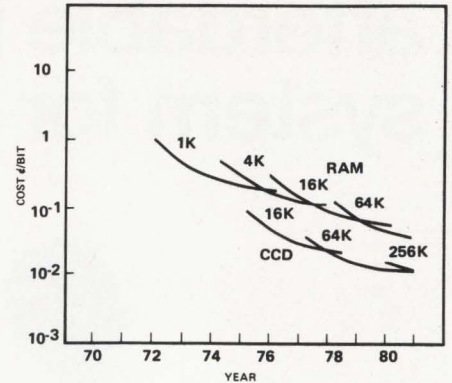


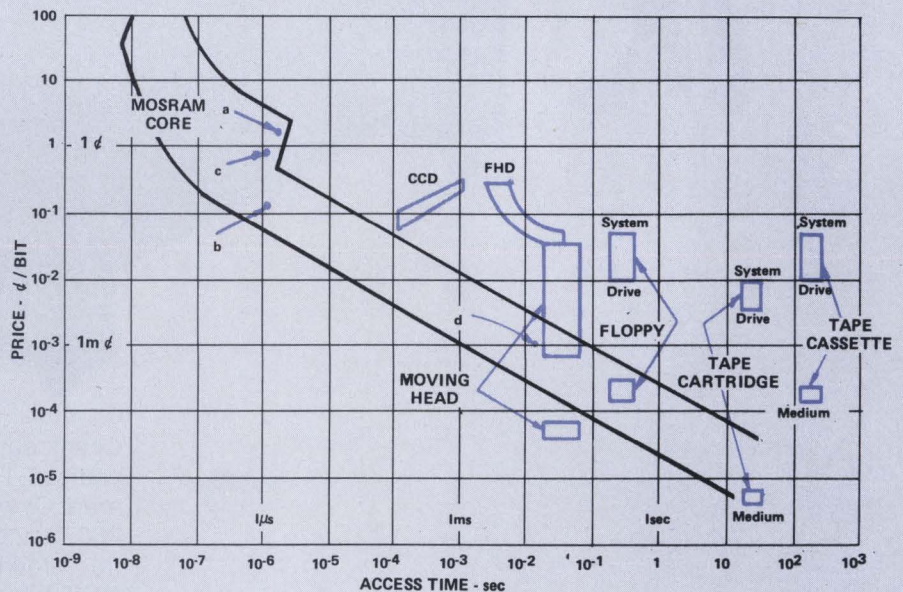
Fig. 2. Dynamic Memory Cost¹

Another 256K-byte system is Modcomp's core storage module, "Memory +." However, this bulk core storage module (not board) plugs into the I/O bus and is intended as an I/O device. The 256K-byte core module was the result of a joint effort by Modular Computer Systems and Dataram Corp. A continuous 128Kx18-bit array is folded around four surfaces of two PC boards, which are hinged together. Modcomp sells the module with one controller and one device file for \$20,000. Dataram, which says it is firmly committed to core, sells the single module for \$6500.

PRICE/PERFORMANCE OF PRESENT STORAGE TECHNOLOGIES¹

Advances are being made in storage technology, both in memory and disk and tape. But, all still fall along the same price/performance "curve." The less expensive the media, the slower the access time. Shown with alphabetical letters are new products discussed in "Memory Movements" and "Winchester Technology for Minis."

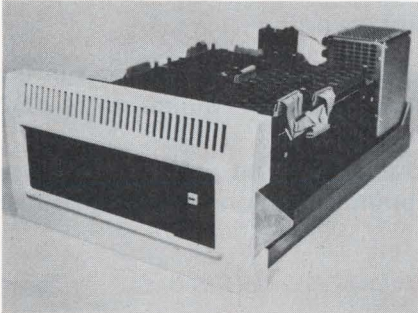
- a. Prime's 256K-byte memory boards using 16K chips (\$35,000)
- b. Dataram's DR-128 Bulk Core Storage System (256K bytes, \$6500)
- c. Modcomp's Memory+, including one controller and one device file (256K bytes, \$20,000)
- d. CDC's Mini Module (24 M bytes, \$3020)



¹Chart taken from Electro '76 paper, "Progress in Memory and Storage Technology," by George Feth of IBM Research Center.

WINCHESTER TECHNOLOGY FOR MINIS

IBM's Winchester technology was originally applied to high capacity disk drives for large-scale machines. Two OEM companies, *Microdata* and *Control Data Corp.* have recently developed Winchester technology on a mini scale. Winchester is IBM's code name for its 3340 Direct Access Storage Facility and the 3348 Data Module. The module contains the disk spindle, recording media, rotary actuator and



THE MINI MODULE FROM CDC is one of the first with Winchester technology for minis. It is interface and format compatible with the rest of the company's disk drives.

data recording heads. Because the head and media are enclosed, there's no need to perform head alignments or read/write adjustments. CDC's 9730 mini module drive stores 24 megabytes (12 and 48 MB models are also being developed) and is priced at \$3020 in OEM quantities. Semi-Winchester technology is used in *Microdata's* Reflex drive. It's a module with head and media, but the module can't be removed. Capacities range from 12.6 to 63 megabytes, depending on the number of disks. Prices will be released sometime in early fall.

INTERDATA FILLS OUT

Two new minis — one on the low end and one in the middle — are filling the gaps in the Interdata product line. On the low end, Interdata has a match for the micro/mini processors with 8K of memory for under \$1000. The difference is that Interdata's 5/16 is not only compatible with the rest of the product line, but is in fact a full-fledged mini with a 16-bit processor on a 15x15-inch board, 114-instruction set, 16 general purpose registers and the standard Interdata bus. It has the speed of a mini, too. On the processor board is 8K bytes of NMOS memory (expandable to 64K) with a cycle time of 600 nanoseconds. Interdata also thought of another thing when it designed the 5/16 — the high cost of peripherals. So it developed an additional bus — the Micro Bus — to interface with low-cost microprocessor I/O devices. The Micro Bus is compatible with I/O buses of the Intel 8080 and the Motorola 6800 and it's almost as fast as the standard Interdata bus:

50K-byte transfer rate vs. 66K-byte. Price of the 5/16 processor board with 8K bytes of memory is \$868 in quantities of 100. With a five-slot chassis, a 25-amp power supply and current loop interface, the 5/16 sells for \$1395 in OEM quantities.

In the medium range and replacing the 7/16 at the top of the 16-bit line is the 8/16. It also has 16 general purpose

HOW INTERDATA'S PRODUCT LINE COMPETES

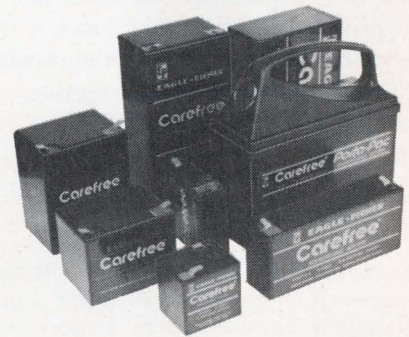
Interdata	Digital	Data General
5/16	LSI-11 11/03	MicroNova
6/16 MOS	11/04	Nova 3
6/16 Core	11/05	
8/16 Core	11/34	
7/32	11/45	Eclipse
8/32	11/70	

registers, direct memory addressing and supports up to 64K bytes of 750-nsec core memory. Options include extended arithmetic, floating point hardware, power fail/auto restart and peripherals. Like the 5/16, the 8/16 runs Interdata's OS/16 MT operating system. Fortran and Basic II are available. Cobol will come later for the Interdata product line. A basic 8/16 in an eight-slot chassis with power supply and 32K bytes of core is \$4160 in quantities of 50.

A NEW DISK HEAD DEVELOPS

Some have said disks have reached an engineering plateau — improvements would be made not in the ferrite core head design but in media, manufacturing techniques and electronics. However, *Applied Magnetic Corp.* (Goleta, CA) is moving uncompromisingly ahead with its development of the thin film head. This follows a license agreement between AMC and CII (Compagnie Internationale pour l'Informatique) of France for transfer of thin film technology. The thin film head uses different read/write physics and a new geometry of operation. It has a small pole face length, which creates the problem of high reluctance. To work around that, AMC varies not just the gap as with other heads, but also the pole face length, the pole face lamination, coil geometry and coil location. What this means in terms of capability is bit densities up to 8000 bpi and frequency ranges to 7.5 MHz (for starters) as opposed to ferrite head capabilities of 6400 bpi and 5 MHz frequency. The manufacturing process is complicated by the fact that there are five factors to consider in head design, rather than just the gap. So AMC uses the computer to optimize the design for each customer's requirements of frequency, media and bit density. If you're skeptical, watch for the initial prototype deliveries scheduled for this fall.

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Mr. Miller is the President of Government Sales Consultants, Inc., a firm that offers consulting services and seminars to computer-related companies and Government agencies seeking help in ADP procurement.

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TURNKEY SYSTEM FOR OEMS

Microdata's Express has the hardware and the operating software for a small turnkey system. But it's not going after the end-user market, but rather the OEM and sophisticated end-user market. With the basic tools from Microdata, the OEM can then design the application software to go after the vertical market he wants. At \$20,000 (Q=1), the basic Express I has a 16-bit microprogrammed, stack architecture processor, 32K words of memory, CRT, 10-megabyte disk drive, 10-megabyte tape cartridge drive, line printer interface and all systems software. The disk is Microdata's new Winchester-type disk, Reflex (see "Winchester Technology for Minis"); the tape cartridge is also new. The Lodestar tape cartridge is the first to offer 10 MB capacity on a 3M-type cartridge. (Although it's dipping into the systems market with Express and especially Reality, peripherals are still Microdata's claim to fame, making up 2/3 of its business.) System software includes Fortran IV, Basic, Cobol and PL/1 derivative EPL. As the Express system programming language, EPL is designed for stack architecture.

There's also Express II, which includes 50 MB disk storage and four RS-232C lines and is priced at \$27,650 (Q=1). Express I can accommodate up to eight terminals; Express II up to 32. Both have expansion capabilities for memory, disk tape, communications, card readers and line printers.

PLASMA GRAPHICS TERMINAL UNDER \$6K

Plasma displays are not new to the industry or to Magnavox. In fact, last year Magnavox introduced the Model 12,000 plasma display with a microprocessor for \$8500, which was used extensively in the University of Illinois Plato computer-aided instruction project. This year, Magnavox has brought the plasma terminal very close to the mass marketable range. And the cabinet is more compact so it no longer resembles an Eastern Bloc terminal. At \$5995, Magnavox's Orion-60 still costs more than a graphic CRT. But because it is plasma, it has certain advantages over a CRT, including features important for a graphics terminal.

With plasma, there are no beams, phosphors or refresh buffers. So CRT-associated problems such as flickering, distortion and skipping simply don't occur. And since the display is a continuous picture, it can be viewed for longer periods than a CRT.

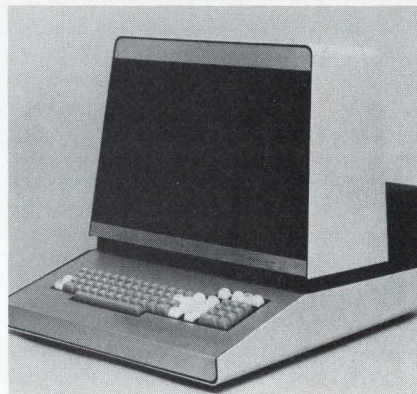
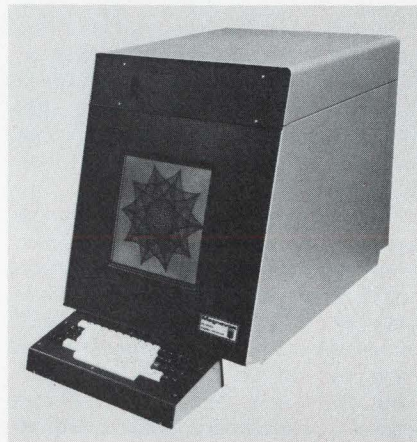
Orion-60 is designed for online operation with HP 2100 Series, DG Nova, DEC PDP-11, CDC 6X00 and 7314, and IBM 360/370. Like its predecessor, the Model 12,000, it also has a touch input option and rear port entry con-

nection that permits attachment of microfiche projection units. The touch panel mounts over and borders the display area. By touching one of 256 entry points, the user can change the display.

Orion-60 is compact because Magnavox put all control logic and vector generators on one processor board. The microprocessor supervises the internal function and output control and communicates with the panel and memories. Screen size is 2048 characters, each character formed by a 7x9 dot format in an 8x16 matrix.

Various firmware options are available at the time of purchase, including an APL character set, incremental vectors, alternate control codes, cursor readout, universal I/O channel and horizontal tab sets.

The callable Fortran subroutine graphics package, GPAC, allows the user to design programs using the spe-



OLD AND NEW FROM MAGNAVOX. The 12,000 (top) of last year had a price of \$8500. This year's Orion-60 (bottom) has a price of \$5995.

cial functions of Orion-60 — touch panel input, microfiche projector addressing, bulk erase, and draw and erase points or vectors. Hewlett-Packard's graphics package designed by HP for the 2000F and Magnavox 10,000 and 12,000 users can also be implemented on Orion-60. There's also an Interactive Previewing Software Package for Calcomp plotters and Interactive Graphics Software Package for IBM 360/370.



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CIRCLE NO. 22 ON INQUIRY CARD

Venturing Forth

Forth, a rich, powerful high-level language for minis and micros, requires little core, but mastering it can be a chore.

Contributing Editor Malcom Stiefel has logged 17 years in the computer field working as a systems analyst, systems engineer, programmer and writer. If you have input for the column, write:

Mini-Micro Software Editor, Mini-Micro Systems, 5 Kane Industrial Drive, Hudson, MA 01749

Of the more than 100 high level computer languages in use in the U.S., only five are widely applied: Cobol, Fortran, Basic, PL/1, and RPG. Intrinsic merit alone does not account for their popularity. The personal prestige of a language's developers and the leadership they show also play a role, as does the Federal government, whose decision to adopt a language can make it succeed. A new contender, by definition, starts out handicapped; it is scorned by prospective users who are unwilling to risk change. But despite the odds against commercial success, new languages do surface, and one tiny California-based company in particular has recently ventured forth into the marketplace with a rich, powerful, high-level language developed for minis and micros.

That language is dubbed Forth. "It's fantastic," says Systems Project Manager Dr. Neil Quinn at General Dynamic's Western Data Center in Pomona, CA. Quinn uses Forth on a 16K Prime computer in an environmental control application. "Forth is easy to use, once a programmer becomes accustomed to it," he says. "The language uses comparatively little core (as little as 6K). It also requires less time for program development than does Assembler, once a programmer builds up a verb vocabulary." Quinn is so delighted that he plans to apply Forth to a numerically controlled milling machine system and a missile simulation system. In fact, the only non-Forth programs Quinn envisions are those where response time is critical. Forth's execution time can be 30 to 300 percent greater than Assembler's.

Forth is a *programming language*, supported by a full complement of support software: compiler, interpreter, assembler, data management system and text editor. In its most basic form as a general purpose high-level system development language, Forth contains the flavor of macro assembler as well as the spirit of Fortran or PL/1. Another version, high-level Forth, con-

sists of only those Forth "verbs" intended for a specific application.

Fighting the battle for Forth's acceptance is Forth, Inc., in Manhattan Beach, CA. Company president and co-founder Elizabeth Rather says Forth so far has been implemented on more than a dozen minicomputers and on RCA's Cosmac microprocessor. Forth has been implemented in over 100 minicomputer installations since it was developed in 1973 by Charles Moore, the other Forth cofounder.

The cost of Forth depends on the version chosen. A typical high-level, full-blown, interactive, multiprogrammed Forth system with virtual memory, including application "verbs" tailored to the user's specifications and ready to run on user-supplied hardware, costs up to \$60K. A bare-bones program development system with all of the Forth features but minimal application preparation goes for around \$10K. And the company is just bringing out a low-cost interactive \$1K package for microprocessor development systems without multiprogramming, only limited file management capability and a small set of primitive "verbs." This package will be available initially for the RCA Cosmac.

HOW TO GO FORTH

"Verbs" are the Forth building blocks, though not verbs in the usual sense. Typical Forth verbs can either execute code or can act as a subroutine, calling in other verbs. But a programmer using "basic Forth" can't escape for very long from needing to get into the innards of the machine. To get full power of "basic Forth," he must know push-down stack-oriented operations in particular—and be prepared to write parts of his program in Assembler, if necessary.

Forth programs are written by "nesting" verbs — or forming complex verbs from simple ones. Assembly language code appears in only a relatively small number of ground level verbs,

and these form the primitives of the Forth language. Other verbs trigger branches to the ground level verbs, which are executed as needed. If the user doesn't want to deal on the assembly language level, he can buy "high-level Forth" — which Forth constructs by designing the complex verbs for him.

Forth saves on core memory because of a nifty design. Unlike conventional macro assemblers, where macro code is stored in a line wherever it is called, a Forth verb appears only once in memory — when defined. Thereafter, every call to the verb results in a branch to the verb. The verb is treated exactly like a subroutine and is interspersed with operands to form a complete program. So Forth programs take half as much memory as conventional Assembler programs and 10 percent as much as Fortran programs, the company claims.

Forth is also a naturally structured language. Like a true high-level language, it has all of the standard constructs — IF...THEN...ELSE; externally controllable DO LOOPS; as well as simple cascaded operations. This clearly sets Forth apart from the macro assembler domain, where such routines are not provided as part of the language.

Forth carries the structured discipline one step further: there are no GO TO's in the language. None at all. To invoke a word in Forth, you don't GO TO it, or PERFORM it; you simply name it. The compiler/interpreter takes care of the bookkeeping automatically, saving addresses on a return stack. A Forth programmer would find it trivial to code a word that contains an unconditional assembly language jump instruction, and he would also have a problem using it. Forth programs don't have any statement labels, in keeping with the structured philosophy. So you can have your GO TO, but there's no place to go to.

Another way Forth saves core included to earlier, is by using a push-down stack for transient data and intermedi-

ate results of calculations. If the parameters of a verb are contained in a transient area in memory and the output from that verb is also stored in a transient area, then the word is inherently reentrant. This means that each time the word is used, the new parameters are ready for it and its output area is available for new data. Since Forth readily defines reentrant words, the language lends itself to a multiprogramming environment where common reentrant routines are shared by several user programs. A reserved area in mem-

data as through it's there whenever he needs it. In effect, the high-level user has a virtual memory capability for working storage.

The secondary storage is also used to hold a source statement library to facilitate program editing. The programmer brings the source code into core by calling for the appropriate block to be loaded from the secondary medium.

In addition to standard sequential files, Forth's file management system supports indexed and random files.

tion. The language specifications ought to be rewritten using Backus-Naur Form (BNF) or some similar notation.

The company helps with some of the problems by giving a three-day intensive course for new users (except purchasers of the \$1K version) with emphasis on hands-on experience.

Then there's the problem alluded to by Neil Quinn — Forth's relatively slow execution time. Although Forth has been used successfully in real-time applications, it isn't as fast as assembly language programs. More compact, perhaps, but not as fast (but faster than Fortran). The hop-skip-jumping necessitated by the program organization, and the need for a control program (part of the basic Forth package) to mind the return stack to keep everything straight carries an inevitable burden in processing time. In many situations, the time difference won't matter; each user must determine his needs independently. The company recommends that time-critical routines be written in Assembler, and the less sensitive parts of the program in Forth.

Since the intended function of a given Forth primitive verb is the same for a variety of computers, the language should be highly portable. Since transfer from machine to machine means recoding the primitives in the assembly language of the target machine anyway, it should be straight forward with the compiler, interpreter, and other programs in the basic package all written in Forth. But the user can get zonked if he finds that there isn't an exact one-to-one correspondence in the function of each primitive verb in Machine A and Machine B. Even a slight difference could entail considerable reprogramming.

Forth, Inc. argues that it is quite successful in maintaining portability in the packages it sells, but that several "non-standard" independently developed versions of Forth exist in a few locations. This implies, of course that the independent versions are less likely to be as highly portable as Forth's own.

Another objectionable feature is the method of naming verbs: A verb name can be up to 128 characters in length, but only the first three letters and the word length are stored in memory. The rest is stripped away. This can lead to ambiguities, confusing the programmer in the debugging process.

BUT MICROS BRIGHTEN FORTH'S FUTURE

The staying power of Forth as a viable language remains to be seen. Despite the obstacles of recognition and acceptance, its core saving features may be just the thing for the core-sensitive world of microcomputers and microprocessors. ■

FORTH	FORTRAN	COBOL
1 { 17 VARIABLE III 5 VARIABLE JJJ }	1 { III = 17 JJJ = 5 }	IDENTIFICATION DIVISION. PROGRAM-ID. SAMPLE. ENVIRONMENT DIVISION. DATA DIVISION WORKING-STORAGE SECTION. 01 VARIABLES. 02 III PIC 9999 VALUE 17. 02 JJJ PIC 9999 VALUE 5. 02 KKK PIC 9999 VALUE ZERO.
2 { : XAVGF + 2 / ; }	2 { XAVGF (IDUMMY, JDUMMY) = (IDUMMY + JDUMMY) / 2 }	PROCEDURE DIVISION 3 { PERFORM XAVGF. DISPLAY KKK. STOP RUN.
3 { III @ JJJ @ XAVGF }	3 { KKK = XAVGF (III, JJJ) PRINT 100, KKK 100 FORMAT 14 STOP END }	2 { XAVGF. COMPUTE KKK = (III + JJJ) / 2. }

Functions:
1. Define and initialize variables.
2. Set up a routine to compute the average of two variables.
3. Execute the averaging routine. Print the result.

FORTH PACKS A LOT IN. An average routine comparison of Forth, Fortran and Cobol shows Forth as the most compact. Forth verbs are defined in the text.

ory is allocated for each user, with his own return stack and his own data stack.

This arrangement lends itself to systems that use an interrupt capability. If Task A calls common reentrant routine R1, then Task B can interrupt the process and call R1 again, if necessary. When Task B surrenders control, the Task A routine will resume where it left off inside R1, completely undisturbed by the intervening Task B activity.

Forth's data overlay capability also helps minimize core usage. Data can be stored on a secondary storage medium (disk, usually), in sequentially ordered blocks, each 1024 bytes long. The blocks form, in effect, part of the workspace of a program. The low-level Forth programmer must supply the block address of the data for a given operation, and then invoke a Forth verb that will summon the block from secondary storage for manipulation. If the core image of the block is subsequently changed by the program, the altered block is written in place of the old block on the secondary medium before another block is read into the overlay area in core.

Each user has his own overlay area, although all users share a common double-sided buffer to pass data to and from secondary storage. A programmer using a high-level application-specific version of Forth doesn't have to worry about these gyrations. He treats the

HITCHES IN THE FORTH PATH

Like every language, Forth has its tradeoffs. For one thing, Forth isn't easy to learn. It's a rich language, and a powerful language, but the user sacrifices syntactic convenience. Forth uses inverted Polish notation, just as Hewlett-Packard calculators do. Not an insurmountable burden, of course. And users claim it's great once you get used to it. But it takes some practice and dedication.

The learning process is made more difficult by the somewhat abstract notation used for some primitive Forth verbs. Two examples:

! = store the data found at (stack pointer - 1) in the address found at the top of the stack.

@ = push the contents of (the memory location found at the top of the stack) to the top of the stack.

= Type the number on top of the stack on the computer console.

This difficulty is compounded by problems with Forth documentation. From what I have seen, it tends to be wordy and ambiguous. An abstract definition of a primitive can be understood only if it is clear-cut — if the effect on memory registers before and after execution is spelled out, which is not the case with Forth documenta-

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The results of the fifth annual market survey among buyers of minicomputers, microprocessors and miniperipherals are now available in a special 80-page report.

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The survey participants reported having 39,000 minis in place as of January 1, 1976 — accounting for nearly 30% of the total installed base of minicomputers in North America.

The survey respondents took delivery on more than 21,000 minicomputers in 1975 at a reported value of \$536 million. The respondents' purchase plans for 1976 include 28,000 minis at a total value of \$733 million.

microprocessors

Nearly one-half of the 5,700 sites represented among the survey replies reported having an active interest in microprocessors.

The respondents reported plans to buy 362,000 microprocessors in 1976 and another 576,000 (up 59%) in 1977. The microprocessor vendors being considered, the distribution by application and word length, and the factors considered most important by prospective buyers of micros when choosing a vendor are tabulated and analyzed in this year's survey report.

miniperipherals

The survey participants reported plans to buy an unprecedented quantity and assortment of peripherals in 1976 for interconnection with their minis and micros. Here is a partial list.

Type of Peripheral	Qty to be Purchased By Survey Participants
CRT Terminals	45,558
Mag Tape Transports	10,276
Floppy Disk Drives	9,909
Disk/Cartridge Drives	13,285
Line/Serial Printers	12,357
Teleprinters	18,466

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MINI CONTROLLERS

Floppy Disk. The microprocessor-based FDC-1 controls up to four floppy drives. Features include drive write protect, automatic CRC generation and check, full IBM 3740-compatible soft sector formatting, automatic track seek verify and head retraction after eight idle disk rotations to ensure long diskette life. An adaptable interface to mini and microprocessor systems like the Intel 8080 is provided with eight bit parallel input and output buses for control information. A DMA interface moves data directly in or out of memory once a transfer is initiated. Driver software for the 8080 is immediately available. Single quantity price for the controller is \$575; a complete floppy system is \$1295. *Digital Systems, Livermore, California.*

Circle No. 152 on Inquiry Card

Quad-Density Tape. It's called "quad density" because one controller can handle four separate data densities. Unlike other controllers that use daisy chain output, the model 5191 has separate parallel outputs for each of four drives. This allows a mix of different tapes on one formatter. The controller is hardware and software-compatible with most minis. Single unit price is \$5400. *Datum Inc., Anaheim, CA.*

Circle No. 155 on Inquiry Card

PDP-11 Tape. This embedded tape controller for both PE and NRZ formats is completely software transparent to DEC PDP-11 computers. The TC-130 controls up to eight industry standard interface tape units. Units accommodate include Kennedy, Bright, Cipher, Wangco and Pertec drives. It occupies four card slots of the PDP-11 and is priced at \$3500. *Western Peripherals, Inc., Anaheim, CA.*

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RUGGED DRUM FOR PDP-11

The 3401 Random Access Bulk Storage System for use with DEC's PDP-11 minicomputer is completely compatible with DEC's RC11/RS-64. The 3401 provides up to 2 million words of storage, an average access time of 8.5 milliseconds and a transfer rate of 4.1 micro-seconds per word. The system may be used in environments where shock, vibration and atmospheric contamination are present. Price is \$21,545 in OEM quantity. *Vermont Research Corp., Springfield, VT.*

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RUGGED MINI

Rolm's 1650 is totally compatible with Rolm's 1600 Series rugged computers and offers computing power equivalent to the widely used 1602. The 1650 is approximately one-third the physical size and weight of the 1602. The microprogrammed CPU, which uses an instruction set identical to that of the 1602, is packaged as a single folded-board module. Other 1650 features in-

clude core memory with a 1.0-micro-second cycle time, microprogrammed floating point and loader routines (optional), single sided access to all CPU and memory modules for easy service and maintenance and captive fasteners on all externally secured modules and covers. Software includes RTOS, RDOS, Fortran, Macroassembler, Basic, and Algol. *Rolm Corp., Cupertino, CA.*

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PORTABLE LINC TAPE

The new Linc Tape system is enclosed in an aluminium carrying case and includes a single slot controller card. A PDP-11 model includes a built-in ROM bootstrap, while a Nova model utilizes the auto program feature. Total weight of the system is 21 pounds. *Computer Operations, Inc., Lanham, MD.*

Circle No. 174 on Inquiry Card

FLOPPY FOR HP 9830A

Infotek's FD-30 floppy disk emulates the cassette system of HP's 9830A programmable calculator so that no changes in existing software are required. The cassette control commands and syntax of the 9830 are completely obeyed and all such programs operate without modification. Price of the floppy with microprocessor-based controller is \$3895. *Infotek Systems, Covina, CA.*

Circle No. 175 on Inquiry Card

SMART FLOPPY FOR MICRO

IMSAI's floppy disk system has one or two disk drives and a microprocessor-based controller format. The controller also contains its own direct access memory, which operates independently, but under command of the Imsai 8080 mainprocessor. Price for a single drive, assembled, with cabinet, power supply and controller is \$1649. An additional drive is \$925. Kits are also available. *IMS Associates, Inc., San Leandro, CA.*

Circle No. 160 on Inquiry Card

A NEW ONE FOR HARRIS

Harris' new Slash 6 incorporates bipolar microprocessor circuits and MOS memory and is fully software compatible with other Slash series computers presently in the field. In the Harris heirarchy of computers, the Slash 6 will fit between the recently-introduced Slash 7 SuperMini and the Slash 4. The MOS memory for the Slash 6 uses 4K RAM chips, which permits packaging of 48K bytes on a single printed circuit board. The memory is expandable in 48K-byte increments to 768K bytes maximum. Single bit error correction using a five-bit code is standard for the MOS memory, while battery backup is optional. A full complement of software and peripherals is available. It is anticipated that the Slash 6 with 48K bytes of MOS memory will be priced at approximately \$14,500 with volume discounts available. *Harris Corp., Ft. Lauderdale, FL.*

Circle No. 134 on Inquiry Card

BOARDS AND BOXES

Information Control Corp. (Redondo Beach, CA) is entering the micro-computer systems market with the Abacus Microsystem and Commander MDS. The modular Abacus Microsystem features rugged, micro-packaging on 2x3-inch PC boards. The microcomputer development system, Commander MDS, features complete software (editor, monitor, and assembler), highspeed audio tape cassette I/O, CRT and optional line printer. Both are available assembled or in kit form.

Circle No. 125 on Inquiry Card

The IMSAI 8080 from *IMS Associates (San Leandro, CA)* is a programmable digital computer for hobbyists. It is constructed around an anodized aluminum card cage and printed circuit mother board, which accommodates the front



panel and up to 22 plug-in cards for memory and I/O interface devices. The 8080 can be expanded to a system with 64K bytes of memory plus a floppy disk controller with its own on-board 8080 microprocessor and a DOS. Peripherals function on an eight-level priority interrupt system. Basic software is available in 4K, 8K and 12K, obtainable in PROM. Price in kit form is \$599; \$931 assembled.

Circle No. 126 on Inquiry Card

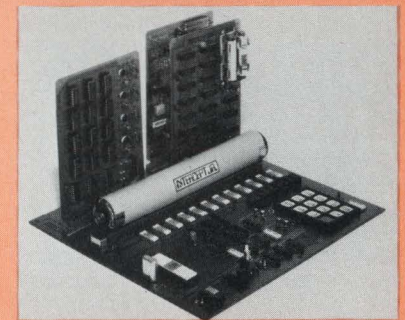
Pro-Log Corp (Monterey, CA) has a processor card that implements the eight-bit 8080A as a fully TTL buffered microprocessor. The 8821 card includes a separate eight-bit data bus input and output; 16 address lines; three-state data, address and memory control for DMA; crystal clock; power-on and external reset; 1K bytes of RAM; capacity for 4K bytes of ROM; external memory control and I/O control. Price in quantity of 100 is \$210.

Circle No. 129 on Inquiry Card

PRINTER FOR HP 2640 CRT

The Model 13246B system consists of an HP 9866B thermal printer, cable and interface card, and permits users to make permanent records of the contents of the 2640 CRT display and memory. The thermal line printer fea-

tures upper- and lowercase alphabet and symbols. Each character is printed by a thermal 5x7 dot matrix print mechanism. The device can print up to 80 characters per line at a speed of 240 lines per minute. Price is \$3675. *Hewlett-Packard, Boise, ID.*



basic module is a CMOS microcomputer on a 10x11-inch double-sided PC board. Also available are CMOS RAM, PROM and serial I/O modules. The Intercept Jr. module is \$281, assembled.

Circle No. 127 on Inquiry Card

The μ MINI 3 from *Monolithic Memories, Inc., (Sunnyvale, CA)* is built around the bipolar, LSI four-bit 6701, microprocessor. The new 16bit μ MINI 3 is aimed at



major OEM and systems manufacturers. It features software and I/O compatibility with Nova computers. Price of a basic 8K system with front panel is \$2500 in quantities of 50. Immediate delivery is available.

Circle No. 131 on Inquiry Card

Pronetics Corp. (Dallas, TX) has a microcomputer based on the F8 microprocessor. Included on one 4.5x6.5-inch card are the microprocessor, 1K-byte RAM, 1K-byte firmware, and 32 bidirectional I/O ports. Memory is expandable with PROM. RAM and cassette program loader modules. Price is \$179.

Circle No. 184 on Inquiry Card

Circle No. 135 on Inquiry Card

PAPER TAPE READER

The Summit-Infranor readers use a brake/clutch capstan drive instead of sprockets for longer tape life. Three series of tape readers are available, each in reader panel, reader fan fold, and reader/spooler models. There is also an individual reader only unit. All models have the capstan drive, use photo-electric sensing and handle five, seven or eight-level tape. Series 2061 reads at 130 cps; Series 2063 reads 300 cps; Series 2066 reads at 600 cps (continuous). *Summit Engineering Corp., Bozeman, MT.*

Circle No. 178 on Inquiry Card

D/A FOR MICROS

The buffering of selected outputs with tri-state gates allows the MN7002 data acquisition system to interface directly with microprocessors and computers. The 12-bit system is expandable to 256 channels, and can operate in either single-ended or true differential modes. Measuring 2.9x4.5x0.35 inches thick, the MN7002 is available in standard and military temperature ranges. In single quantity, the MN7002 is priced at \$495. *Micro Networks Corp., Worcester, MA.*

Circle No. 164 on Inquiry Card

32K-Word Core. ECOM R is a standalone 32Kx18-bit word core memory module for OEMs. Included on a single PC board are timing and control, memory bus interface and core array drive circuits. Access time is 300 nanoseconds; cycle time is 750 nsec. Price is \$2400 in single quantity. *Standard Memories, Newport Beach, CA.*

Circle No. 151 on Inquiry Card

370-168 MOS. The in-7168 Solid State Memory System stores up to 8 megabytes (1 IBM) in a single, standalone 37x40-inch frame. The unit uses 4K RAMs as storage and a microprocessor to expedite maintenance. Lease prices range from \$4500 per month for 1 megabyte to \$32,000 per month for 7 megabytes. *Intel Memory Systems, Sunnyvale, CA.*

Circle No. 187 on Inquiry Card

Micro Core. The MCM-8300 single-card module stores 1024 eight-bit words. Access time is 450 nsec. Also available are 512- and 256-word versions. Prices in large OEM quantities start at \$180. *Ampex Corp., Marina del Rey, CA.*

Circle No. 146 on Inquiry Card

MINI UPS

The Elexon Uninterruptible Power Supply features a precision power supply charger circuit that provides a float charge to the backup battery, as well as driving the dc-to-dc converter. The dc-to-dc module operates at a low frequency to minimize EMI, RFI and noise spikes, and automatically switches over to battery power with no transients or any loss of power. The modular design of the UPS permits the number of outputs and specific voltages and currents to be readily modified, within a total output power of 18 watts. Because of its small size (4x4x8 inches) and low cost (\$87.50), it can be used for minis and terminals. *Elexon Power Systems, Santa Ana, CA.*

Circle No. 190 on Inquiry Card

CASSETTE FOR PDP-11

Datum's Model 4000 Cassette Recorder has an interface controller board for the PDP-11. The controller emulates DEC's paper-tape reader, but provides 1000-cps read/write capability. This compares to DEC's paper tape read of 300 cps and punch of 50 cps. Unit price for single transport is \$3150; for the dual transport, it's \$4145. *Datum, Inc., Anaheim, CA.*

Circle No. 176 on Inquiry Card

ADD-IN/ADD-ON MEMORIES

256K-Byte RAM. The NS3 system consists of four 64K-byte cards, a timing and control card, an optional special features card and optional custom interface card. The basic storage element is National Semi's MM5270 4K dynamic RAM. Access time is 280 nsec; cycle time is 430 nsec. All cards are housed in a 5.25-inch high cabinet. Price for the system with power supply is \$11,000. *National Semiconductor Corp., Santa Clara, CA.*

Circle No. 186 on Inquiry Card

65-KB Core for Interdata. Using only eight slots of an Interdata 7/32 chassis, it's possible to have 500K bytes of memory. TTL loading per input line permits bypassing LMBI. Access time is 240 nsec; cycle time is 650 nsec. Price for eight cards is \$25,600. *Pushpa International Corp., Westminster, CA.*

Circle No. 148 on Inquiry Card

Core for Intel. This 8Kx8 RAM core memory system plugs in directly to connectors of Intel's Intellec 8 microcomputer. Data access time is 350 nsec and cycle time is 1.0 μ sec. *MicroMemory, Inc., Chatsworth, CA.*

Circle No. 147 on Inquiry Card

PROM PROGRAMMER KIT

The 2708 PROM Programmer Cramer-kit provides an easy way of programming PROMs with Intel's System Design Kit microcomputer. It can be interfaced to an Intel or any other microcomputer through two 16-pin jack areas on the panel. Price is \$129.95. *Microcomputer Technique, Inc., Reston, VA.*

Circle No. 173 on Inquiry Card

GRAPHICS FROM A/N TERMINAL

The 4662 digital plotter produces graphics from an alphanumeric display terminal. It has an RS-232C interface; all that's required is a modem and the



terminal. The plotter uses stepping motors instead of slide wire feedback servomotor techniques. A microprocessor controls acceleration/deceleration for high-speed vector generation. Price is \$3995. *Tektronix, Inc., Beaverton, Oregon.*

Circle No. 165 on Inquiry Card

Sphere 4K ROM. This board plugs into the standard Sphere computer system bus cables and uses the commonly available 1702A erasable PROM. The address interface logic is fully buffered to present only one standard load to the address lines while the data interface is tri-state logic driven. Price is \$156. *Sphere Corp., Bountiful, UT.*

Circle No. 150 on Inquiry Card

PDP-11 Add-On Core. The Model 7011 add-on core is available in 32K-word increments up to 1024K words. It is electrically physically compatible with the DEC MJ11-AA memory system. The basic model consists of 128K memory, memory controller, chassis, power supply and cabling. Price is \$18,250. *Fabri-Tek, Inc., Minneapolis, MN.*

Circle No. 157 on Inquiry Card

128K-Word Core. Developed jointly by Modcomp (Ft. Lauderdale, FL) and Dataram Corp. (Cranbury, NJ), the DR-128 is the largest capacity single-board core memory system with 128K x18-bit words. Access time is 650 nsec; cycle time is 1.3 microseconds. Price is \$6500 in single quantity. *Dataram Corp., Cranbury, NJ.*

Circle No. 185 on Inquiry Card

KEYED ACCESS FOR FORTRAN IV

ISAM70 overcomes the file accessing limitations of standard Fortran IV access methods. By giving the user the ability to read and write disk records with an alphanumeric or binary key. The user can create a new keyed access file; add, update or delete keyed records; inquire about the existence of a particular key in the file; and copy ISAM70 files. ISAM70 requires a minimum of 2K words and runs on the DEC PDP-11, Data General Nova, General Automation SPC-16, IBM 360/370 and System/3 and others. One-time lease fee is \$150. *Software '70, Anaheim, CA.*

Circle No. 212 on Inquiry Card

PUBLIC ACCOUNTANT PROGRAMS

System/32 Client Accounting and Financial Reporting System helps tailor reports to client needs and incorporates the basic functions of journal entry, general ledger posting, trial balance printing and statement preparation. Enhanced functions such as automatic journal entries, ratio analysis, common unit income and expense reporting are also provided. Initial charge is \$1345; monthly license fee is \$67. *International Business Machines Corp., General Systems Div., Atlanta, GA.*

Circle No. 216 on Inquiry Card

MEASUREMENT VIDEOTAPE

"The Data Domain, Its Analysis and Measurements," is a videotape series that provides instruction in logic state analysis, measurement techniques and the debugging of processor-based digital systems. This tape is an abridged version of Hewlett-Packard's "Digital Seminar in the Data Domain." The four-tape series consists of 13 programs, each 10 to 20 minutes long. Price for the complete set is \$650. *Hewlett-Packard, Palo Alto, CA.*

Circle No. 215 on Inquiry Card

TERMINAL SECURITY

Remote Entry Flexible Security is a data security system which can be used by an application system requiring controlled access to specific IMS transactions. REFS recognizes each user's ID code and authorized transactions. It controls the use of specific transactions and allows authorized persons to access their authorized transactions at any 3270 CRT. *Suntech Computer Services, Wayne, PA.*

Circle No. 219 on Inquiry Card

DATAGUARD CENTER

A newly rebuilt Dataguard Center in New York centralizes Bonded Services protection service of EDP records. The center is a fireproofed concrete-block and steel structure and has a capacity for more than 100,000 tape reels and disks. It's equipped with automatic chemical fire-suppressant systems and electrostatic air filtration. *Bonded Services, New York, NY.*

Circle No. 220 on Inquiry Card

MINI DATA BASES

Now there's an interactive data base system for the small mini - about the size of the HP 21MX. IMAGE/1000 from Hewlett-Packard (Palo Alto, CA) is a multiterminal, multi-program enhancement of HP's IMAGE/DOS, and a subset of IMAGE/3000. It requires only 32K words of memory, but can be expanded to 60M words with additional disk files. One special feature is QUERY, which allows the user to retrieve and update information and generate reports online with English-like commands. Price of IMAGE/1000 is \$6000.

Circle No. 202 on Inquiry Card

Digital Equipment Corp.'s (Maynard, MA) DBMS-11 is based on Cullinane Corp.'s IDMS data base management package. Available for the PDP-11/70, DBMS-11 is said to be the first codasyl-compatible data base available for a midicomputer. The software includes date description and data manipulation languages that function as high-level extensions to Cobol-74.

Circle No. 203 on Inquiry Card

Data Boss from Florida Computer, Inc. (North Miami, FL) is a generalized data base management system currently implemented on DEC's PDP-11 under the RSTS/E operating system. Included in the system is a generalized applications monitor which provides multilevel password protection, uniformity of appearance of all applications, and high level system documentation. Data Boss has been implemented in a production environment for two years.

Circle No. 201 on Inquiry Card

Release 2 of BIS/3000 data base system from Data Base Management Systems, Inc. (North Miami, FL) is available now for HP 3000 CX and HP 3000 Series II users. BIS/3000 contains a menu selection command interpreter, a structured programming language, a DBMS, an error checking input subsystem and a report generator.

Circle No. 205 on Inquiry Card

IBM PROGRAM DEVELOPMENT

Three new programming development aids are available from IBM. The Generalized File Maintenance System is a series of file maintenance programs designed to edit the input and update VSAM, ISAM or sequential files. The CICS/COBOL Interface IUP (5796-AEG) provides a COBOL/CICS interface technique that eliminates the use of the CICS Preprocessor Program and makes writing and debugging of ANS COBOL/CICS application programs considerably easier. The ISAM-to-DL/1 COBOL Program Translator Installed User Program assists the user in his conversion from ISAM files to integrated database management under DL/1. *International Business Machines Corp., White Plains, NY.*

Circle No. 213 on Inquiry Card

FILE ACCESS FOR INTERDATA

OASIS-16 is a sophisticated file access method, operating under Interdata's OS16/MT-II operating system. It can retrieve records with up to nine different keys using a multilevel, balanced tree index structure. The indices are dynamically maintained and the data record area is randomly, dynamically used and reused to eliminate the gradual degradation characteristics of many file management systems. The re-entrant OASIS-16 run-time subroutines, coupled with the compact program sizes produced by the COBOL compiler, permit the implementation of large interactive, online data base applications on Interdata 16-bit computers.

For Interdata 32-bit machines, a file manager, consisting of ISAM-II and the Transaction File Manager, is available. *Diversified Data Systems, Inc., Tucson, AZ.*

Circle No. 218 on Inquiry Card

8080 BASIC

The Micro Basic I compiler operates on the 8080 CPU and includes text editor, loader, debugger and runtime support. The program is supported by two subsystems: LOAD & GO and RUNTIME. The RUNTIME package contains all the arithmetic, string handling, I/O, and control routines required to execute a Basic program. The LOAD & GO includes the Runtime plus a relocating linking loader. Both are available now in PROMs from Hamilton/Avnet and will soon be available in ROMs as well. *Ryan-McFarland Corp., Rolling Hills Estates, CA.*

Circle No. 210 on Inquiry Card

ONLINE PROGRAM DEVELOPMENT

Working Set VS is an online CICS/VS transaction that presents a graphic picture of a DOS/VS partition on a 3270 CRT or equivalent by indicating each page that is involved in that partition's working set. It can be used in the design and debugging of new programs, scheduling, and measuring CPU utilization and CICS/VS tuning. Price is \$1000. *Software Module Marketing, Sacramento, CA.*

Circle No. 207 on Inquiry Card

GRAPHICS SOFTWARE

Integrated Versaplot Software (IVS), version 6, provides compatible programming among various operating systems and electrostatic printer/plotter models. This Fortran application program is transportable between DEC, DG, H-P, Interdata and IBM computers. With the new package, programming speed is said to be tripled and core requirements reduced by 20 percent. *Versatec, Santa Clara, CA.*

Circle No. 214 on Inquiry Card

MULTITASKING OS FOR 6800

MTOS-68 is a real-time multitasking operating system for the Motorola M6800 microprocessor. The system consists of a 3K-byte control program in ROM, a 256-byte scratchpad RAM and an adjustable interrupt clock. It is available as a board, which plugs directly into any Motorola EXORciser. Price in the board form is \$2000. *Industrial Programming, Greenvale, NY.*

Circle No. 217 on Inquiry Card

TERMINAL TAB STOP OPTIMIZER

Using human intuition for setting tab stops for printed images evidently has its limitations. TABLEAU performs feasibility testing for tab stops as well as automatic setting of tab stops. Input to TABLEAU is a tape or disk containing the print images of the report to be analyzed. TABLEAU output is a single-page bar graph, which can be easily interpreted in terms of cost and performance. The one-time charge for TABLEAU, written in ANS Cobol is \$650. *Bi-Hex Co., New York, NY.*

Circle No. 221 on Inquiry Card

CONTAINER OPERATION APPLICATION

The Fully Optimized Container Analysis (FOCAS) system is designed to meet the total management and control needs of container operations, including: container and ship management, lease control, sales and accounts receivable, tariff analysis, agent commissions and intra-company communications. *Systems Development Corp., Santa Monica, CA.*

Circle No. 211 on Inquiry Card

HARD COPY FOR 3270

The IMS 3270 Local Copy Installed User Program, which was developed by the Hamilton Standard Division of United Technologies Corp., provides a hard copy facility for printing 3270 displays on locally attached components of the IBM 3270 information display system. Written in assembler language, the program is available for a monthly charge of \$190. *International Business Machines Corp., White Plains, New York.*

Circle No. 209 on Inquiry Card

Microprocessors and Microcomputers

A TECHNOLOGY PROFILE

Comprised of material which appeared in the January and February, 1975, issues of this publication, this 24-page Technology Profile is the most thoughtful and comprehensive effort to date to organize and summarize the complex, confusing, and fast-moving world of micro systems. This booklet will serve, for years to come, as a primer to the newcomer and a review guide for the more experienced.

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IC SHORTFORM CATALOG

MMI's Bipolar ROMs, PROMs, RAMs, and computer logic devices are the subject of this 24-page short-form catalog. Key specs, applications, pinouts, and block diagrams are provided for each IC. *MMI, Sunnyvale, CA.*

Circle No. 254 on Inquiry Card

REMOTE PROCESSORS

As a description of the Entrex 600 Series of remote processors, this six-page brochure explores these areas: the parameterized communications capabilities, including batch communications, transaction communications and network optimization; new software features such as security, data capture and system management; and hardware features including a virtual-memory processor. *Entrex, Burlington, Massachusetts.*

Circle No. 255 on Inquiry Card

GRAPHICS DISPLAY

Genisco's GCT-3000 series graphic display systems are highlighted in this full-color, foldout brochure. The display system uses a modular design so systems can be built up from single-monitor black and white to multi-monitor full color installations to give thus user the degree of complexity he needs. Typical display applications illustrated in the brochure include flight simulation, weather data processing, satellite picture processing, industrial controls, alphanumeric indexing and business statistics. *Genisco Technology Corp., Irvine, CA.*

Circle No. 253 on Inquiry Card

HARRIS SYSTEMS

The Series 100 and 200 from Harris are the subjects of the 14-page, full-color brochure. The minis are virtual memory systems for a wide variety of applications from commercial processing to real-time data acquisition. *Harris Corp., Computer System Div., Fort Lauderdale, FL.*

Circle No. 260 on Inquiry Card

POWER SUPPLIES

Pioneer's family of single and multiple output, high-current power supplies are described in this six-page brochure. "Brownoutproof" is the most important advantage of Pioneer's Dependable line of power supplies. *Pioneer Magnetics, Santa Monica, CA.*

Circle No. 263 on Inquiry Card

MINI-MICRO NEWS

Not *Systems*, but *News*. This eight-page biweekly newsletter tells the latest in the mini-micro scene — financial, industry and product news are all included. And the product line clearinghouse gives the trader his chance, too. *Modern Data Services, Inc., Hudson, MA.*

Circle No. 251 on Inquiry Card

COMMUNICATION BUZZ WORDS

Whether or not Sherry is a good vehicle for communication buzz words can be disputed. Nevertheless, "Sherry's Guide To Data Communication Buzz Words" is an updated version of the 1972 guide. Now it's 24 pages and includes terms relating to terminals and data processing. *International Communications Corp., Miami, FL.*

Circle No. 252 on Inquiry Card

COMPUTER RIBBON CATALOG

Frye Data Processing Ribbons, made for more than 300 high-speed printers, key punch, console and teleprinters, are described in this catalog. Ribbon materials are: nylon for heavy duty wear and high-speed service, thinner Fryelon for multiple copies of OCR applications, and Mylar for OCR or other applications requiring sharpness and clarity. *Frye Copysystems, Inc., Cincinnati, OH.*

Circle No. 259 on Inquiry Card

BOOK CATALOG

The Spring 1976 Catalog of Scientific and Technical Books lists over 500 scientific and technical paperbacks and 300 hardcover titles available at discount prices. Topics covered include physics, chemistry, mathematics, biology & life sciences, medicine, psychology, electronics and various branches of engineering, earth science and astronomy. *Herbert Shprentz Co., Irvington, NY.*

Circle No. 256 on Inquiry Card

PROCESS CONTROL TRAINING

Honeywell's process computer training facilities are described in this folder. Honeywell offers training in process automation hardware and software, covering equipment theory and maintenance, programming and software analysis. All courses are oriented to Honeywell process computers and appropriate software. *Honeywell Process Control Div., Phoenix, AZ.*

Circle No. 275 on Inquiry Card

PROGRAMMABLE CALCULATOR APPLICATIONS

Two application summaries describe statistical software libraries for the HP 9815 and HP 9825 desktop programmable calculators. Each software library contains three volumes of applied statistical programs that range from determination of the mean to calculation of an 11-variable multiple regression. *Hewlett-Packard Co., Palo Alto, CA.*

Circle No. 258 on Inquiry Card

LSI TEST SYSTEMS

This six-page, full-color brochure from Macrodata describes its multi-user LSI test systems — the MD-501 and MD-501MS. Illustrations include several color photos of the system, a system block diagram, and a group of Management Information Software Packages. The brochure pinpoints the various levels of manufacturing that can benefit by the use of a versatile LSI tester, and provides complete system features and specifications. *Macrodata Corp., Woodland Hills, CA.*

Circle No. 268 on Inquiry Card

GRAPHICS DISPLAY

The Hughes Aircraft Co. line of interactive computer graphics display terminals are described in this eight-page booklet. The terminals use the patented Conographic curve generator that displays curvilinear information by converting all contour data to conic curves, resulting in reduction in data required. *Hughes Aircraft Co., Carlsbad, CA.*

Circle No. 271 on Inquiry Card

ANALOG INPUT CONTROLLER

Technical information, typical applications and ordering information are provided for Computer Products' RTP7480 Wide-Range Analog Input Controller in this eight-page technical bulletin. The RTP 7480 is a complete A/D subsystem designed to operate with most minis. *Computer Products, Ft. Lauderdale, FL.*

Circle No. 273 on Inquiry Card

A/D CONVERTER

This "minibrochure" describes the 6100 Series of microprocessor compatible, multislope, integrating A/D converters, featuring tri-state output and 13-bit resolution. Complete specifications, prices, outline dimensions and pin connections for the modules are provided. *SGR Corp., Canton, MA.*

Circle No. 266 on Inquiry Card

TAPE PAC

Emerson's recently introduced Series 2000 Tape Pac System is illustrated in this four-page brochure. The Tape Pac is not a cassette or cartridge, but an enclosed 1/2-inch reel-to-reel. Included is a description of the subassemblies. *Emerson Electric Co., Santa Ana, CA.*

Circle No. 257 on Inquiry Card

CORE MEMORY

Fabri-Tek's Model 696 and 698 core memory systems are described in this four-page, full-color brochure. The 696 is a 16Kx18-bit word system; the 698 is a 32Kx18-bit word system. *Fabri-Tek, Inc., Minneapolis, MN.*

Circle No. 269 on Inquiry Card

MINICOMPUTER ACCESSORIES CATALOG

Minicomputer accessories, connectors and cables are illustrated in this 24-page catalog. It includes many new products: I/O cables and connectors for DEC, Data General, and HP computers; disk cartridges and magnetic tapes with a five-year guarantee; and a completely new media storage system. *Minicomputer Accessories, Palo Alto, California.*

Circle No. 267 on Inquiry Card

NOVA INTERFACES

General purpose logic modules, peripheral device controllers, and wire wrapping boards for Nova computer users are described in this folio of technical information. New products include a Nova expansion chassis with an optional selection of three power supplies, and ASGOL, a high-level, structured programming language. *MDB Systems, Inc., Orange, CA.*

Circle No. 264 on Inquiry Card

μP POWER SUPPLIES

Described in this technical brief are the new MPS Series microprocessor power supplies, which have prices as low as 55 percent less than the company's MPU Series units. The new series consists of two models: Model MPS-1 is rated at 5 vdc at 3 amps, 12 vdc at 0.6 amps, and 9-12 vdc adj. at 0.6 amps or 5 vdc at 0.38 amps; Model MPS-2 is rated at 5 vdc at 7.0 amps, 12 vdc at 1 amp, and 9 vdc at 1.2 amps, or 5 vdc at 0.75 amps. Prices start at \$77 *Deltron, Inc., North Wales, PA.*

Circle No. 270 on Inquiry Card

UNDERSTANDING SDLC

A 12-page reprint collects and *updates* the series of five articles on IBM's Synchronous Data Link Control (SDLC) line protocol which appeared in MODERN DATA between February and September, 1975. *Not included in the published series but contained in the reprint* are several pages on the derivations of the equations used in the articles. Taken together, the series provides a comprehensive, independent explanation and appraisal of this most important line protocol, *written in the working language of computer-communications users.* SDLC subjects covered include:

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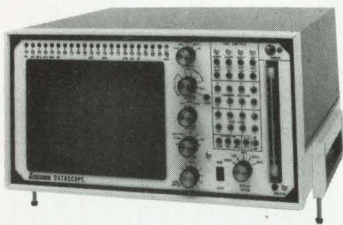
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